

CONTRACT DOCUMENTS  
FOR  
INDEPENDENCE TOWNSHIP  
BAY COURT PARK – MAINTENANCE GARAGE

PREPARED BY:  
NOWAK & FRAUS ENGINEERS  
46777 Woodward Avenue  
Pontiac, MI 48342

NFE JOB NO. M383-01

FOR:  
INDEPENDENCE TOWNSHIP DEPARTMENT OF PARKS AND RECREATION  
6483 Waldon Center Drive  
Clarkston, MI 48346

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INDEPENDENCE TOWNSHIP  
BAY COURT PARK – MAINTENANCE GARAGE  
NFE JOB NO. M383-01

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## ADVERTISEMENT

Sealed Bid Proposals for the construction of the INDEPENDENCE TOWNSHIP BAY COURT PARK – MAINTENANCE GARAGE in Oakland County, Michigan will be received by the Clerk of the Owner, Charter Township of Independence, 6483 Waldon Center Dr. Clarkston, MI 48346 until **2:00 PM Local Time on Tuesday, August 8, 2023.**

This project consists of the installation of a new 1,500 SFT heated garage addition, with connectivity to the existing maintenance garage at the Brady Lodge facility located at 6970 Andersonville Road Independence Township, Oakland County, Michigan.

A pre-bid meeting to allow bidders to review the site and existing building is scheduled for July 18, 2023 at 10:00am. While recommended, this meeting is not mandatory.

All work shall be in accordance with the Bidding Documents prepared by the Engineer. Each sealed Proposal shall be marked **“INDEPENDENCE TOWNSHIP – BAY COURT PARK MAINTENANCE GARAGE”**.

Bidding Documents, which must be used in submitting a Bid, may be examined and secured from BidNet Website.

Attention is called to the fact that for all parts of the Project, no less than the minimum salaries and wages must be paid on this Project as required by the Minimum Wage Act of 1964, as amended, MCL §408.381, et seq, and that the Contractor must ensure that employees and applicants for employment are not discriminated against because of their race, color, religion, sex or national origin, in accordance with the Elliott-Larsen Civil Rights Act, MCL §37.2101, et seq.

The Township reserves the right to accept or reject any or all bids, waive or modify proposal requirements, waive informalities, allow correction of errors or omissions, negotiate individually with one or more proponents, request supplemental bids and/or additional information, and to select and award a contract to a qualified contractor as determined by the Township, in its discretion, to be in the best interest of the Township considering all factors. Bids shall be evaluated by the Department Director seeking the bids based on the requirements set forth herein. The Contract shall be awarded by the Township Board, and notice shall be provided to the successful bidder by the Department Director seeking the bid award

**Published: 7/5/23**

By: Cari Neubeck, Township Clerk  
Charter Township of Independence Township

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## INSTRUCTIONS TO BIDDERS

### 1. PREPARATION OF PROPOSAL

The Proposal shall be typewritten or legibly prepared with ink on forms provided herein. The Bidder shall properly fill in blank spaces provided in the Proposal form. The Bidder shall show, in the column provided therefore, the products of the respective quantities times the Unit Prices; and he shall show the sum for which he will perform the proposed work. The Proposal shall be legally signed and the complete business address of the Bidder given thereon. In the event that any entry made by the Bidder in the Proposal is to be altered, it shall be crossed out with ink. The new entry shall be made and initialed by the Bidder in ink.

### 2. INTERPRETATION OF PROPOSAL QUANTITIES

The quantities as shown in the Proposal shall be used for the comparison of Bids upon which the award of the Contract will be made. These quantities are not guaranteed, and the furnishing of this information creates no liability on the part of the Owner. The actual quantities of work to be performed are subject to increase or decrease as determined by conditions encountered in the prosecution of the work.

### 3. DISCREPANCIES

In case of a discrepancy between the Unit Price and the extended amount for any Item, the Unit Price figure shall govern.

### 4. MODIFICATIONS

Proposals shall not contain any recapitulations of the work to be done. No alternate Proposals will be considered unless specifically called for. Oral Proposals or modifications will not be considered.

### 5. EXAMINATION OF CONTRACT DOCUMENTS, SITE OF WORK, AND SOIL CONDITIONS

Before submitting a Proposal, Bidders shall carefully examine the Project site, review this entire Contract Document, and employ such other means as may be preferred and required to prepare and submit a Bid. Bidders shall fully inform themselves as to all existing conditions and limitations, including the existing soil and groundwater conditions which might affect the work to be performed. Soils information, if available, will be included in the appendix of this Document.

All work to be performed under this Contract shall be paid for under the specific bid items set forth in the Proposal. The Bidder should include in his Bid the cost of performing all work required under this Contract. No payment will be made to the Contractor for considerations other than those included and established by the Bid Proposal.

#### 6. DELIVERY OF PROPOSAL

Proposals shall be delivered by the time and to the place stipulated in the Advertisements. It is the sole responsibility of the Bidder to see that his Proposal is received in proper time. Any Proposal submitted after the deadline for submission of proposals shall not be accepted by the Owner and shall be returned to the Bidder unopened.

#### 7. WITHDRAWAL OF PROPOSAL

Any Bidder may withdraw his Proposal, in writing, at any time prior to the deadline for submission of Proposals.

#### 8. OPENING OF PROPOSAL

Proposals will be publicly opened, identified and subject to disclosure under the Freedom of Information Act at the time and place set forth in the Advertisement.

#### 9. INTERPRETATION OF DOCUMENTS

If any person contemplating submitting a Proposal is in doubt as to the true meaning of any part of the Drawings, Specifications, or other Contract Documents or finds discrepancies in or omissions from the Drawings or Specifications, he may submit to the Engineer a written request for an interpretation or correction thereof. The person submitting the request will be responsible for its prompt delivery. Any interpretation or correction of the Documents will be made only by Addendum duly issued and a copy of the Addendum will be made or delivered to each person receiving a set of Contract Documents. Neither the Owner nor the Engineer will be responsible for any other explanations or interpretations of the Contract Documents.

#### 10. ADDENDA

Any Addenda issued during the time of bidding, or forming a part of the Contract Documents furnished to the Bidder for the preparation of his Proposal, shall be covered in the Proposal and shall be made a part of the Contract. Receipt of each Addendum shall be acknowledged in the Proposal.

#### 11. BIDDERS INTERESTED IN MORE THAN ONE PROPOSAL

No person, firm, or corporation shall be allowed to make, file, or be interested in more than one Proposal for the same work, unless alternate Proposals are called for. However, a person, firm, or corporation who has submitted a subproposal to a Bidder, or who has quoted prices on materials to a Bidder, is not hereby disqualified from submitting a subproposal or quoting prices to other Bidders.

#### 12. INSURANCE REQUIREMENTS

The successful Bidder will be required to furnish the insurance coverage as called for in the GENERAL PROVISIONS OF THE CONTRACT.

#### 13. REJECTION OF PROPOSALS

Proposals will be rejected if the Bidder fails or neglects to fill in any Unit Prices, fails or neglects to complete the Base Bid, the Proposal is filled out in pencil, the Proposal is not signed, or no Proposal Guaranty is included. Proposals may be rejected if they show any alterations, are conditional or irregular in any way, are unbalanced, or do not indicate acknowledgement of Addenda.

#### 14. BIDDER'S QUALIFICATIONS

Bids are solicited only from responsible Bidders known to be skilled and regularly engaged in work of similar character and magnitude to that covered by the Contract Documents.

After the opening of Bids, the Bidder shall promptly submit a certified written statement with the following information, if requested by the Engineer:

- a. The Bidders accrual basis balance sheet as of end of last fiscal year, certified by an independent CPA.
- b. The Bidder's financial statement showing his net equity of construction equipment and depreciation of construction equipment certified by an independent CPA.
- c. The Bidder's statement of available equipment and experience records showing:

1. Evidence that the Bidder owns or currently leases the major equipment items necessary to perform the work or a copy of a lease agreement or purchase order indicating it shall purchase or lease the major equipment necessary to perform the work.
  2. Experience record of the Bidder's key personnel which makes them capable of performing the work including the name of the Project superintendent proposed for the work.
- d. The Bidder's list of outstanding contracts with the tabular list of value of uncompleted work.
- e. List of all contracts (over \$100,000 in value each) entered into within the last 5 years with a statement showing for each:
1. Current status of completion
  2. Name, address, and phone number of project owner
  3. Name of owner's representative
- f. The Bidder shall list the major parts of the work proposed to be sublet, the name of the Subcontractor, and the value of each part to be subcontracted.

In addition to the above, and when so requested by the Engineer, the Bidder shall meet with the Owner and his Representatives and give further information in relation to such other matters as the Owner may deem necessary in order to determine the Bidder's qualifications, responsibility, and ability to perform and complete the work in accordance with the Contract requirements.

#### 15. RESERVATIONS

The Owner reserves the right to accept or reject any and all Proposals received; to waive any defect or irregularity in the Proposals; to accept and separate items in the Proposals; to reject low proposals, or to accept a higher proposal; to award this project to the bidder it deems best to serve the overall interest of the Owner; to award, in any combination, the listed herein; and reserves the right to re-solicit proposals if it is deemed to be in the best interest of the owner.

#### 16. AWARD OF CONTRACT

The Township reserves the right to accept or reject any or all bids, waive or modify proposal requirements, waive informalities, allow correction of errors or omissions, negotiate individually with one or more



proponents, request supplemental bids and/or additional information, and to select and award a contract to a qualified contractor as determined by the Township, in its discretion, to be in the best interest of the Township considering all factors. Bids shall be evaluated by the Department Director seeking the bids based on the requirements set forth herein. The Contract shall be awarded by the Township Board, and notice shall be provided to the successful bidder by the Department Director seeking the bid award

#### 17. EXECUTION OF CONTRACT

Six original counterparts of the Agreement, and at least one original of each Insurance Certificate(s) confirming required Policies, and other Contract Documents will be required to be executed.

#### 18. TIME OF STARTING AND COMPLETING THIS WORK

Upon approval and confirmation of the executed Contract, the Owner will issue a written Notice to Proceed to the successful Bidder. The Bidder thereby agrees to commence work on this Contract within 10 days after receipt of the Notice to Proceed. The Bidder further agrees to fully complete the work within the number of consecutive calendar days indicated in the Proposal.

Time being of the essence for this Contract, the Contractor shall prosecute the work diligently so as to assure the completion of the entire work not later than the time prescribed, or the date to which the time of completion may have been extended pursuant to the provisions of the GENERAL PROVISIONS. The Contractor shall, if necessary to complete the work within such time, and if requested and approved by the Township in its sole discretion, work nights, Saturdays, Sundays, and holidays without any change in the Contract Price.

Final completion of the entire work of this Contract consists of completing all work called for in these Contract Documents. This work will include (but not be limited to): furnishing and installing all materials and equipment so as to provide a completed operating facility as intended, seasonal restoration, completion of punch-list items, resolution of claims and complaints, submission of all documents required, and conformance with all Contract provisions.

#### 19. LIQUIDATED DAMAGES

The Owner shall have, and is hereby given the right to deduct and retain from monies due the Contractor, not as a penalty but as liquidated damages, the sum of money as stated in the Proposal for each and every day that the work is delayed in its completion beyond the specified time.

THE FOLLOWING PROPOSAL IS HEREBY MADE TO:

Charter Township of Independence Township  
OWNER

6483 Waldon Center Road  
BUSINESS ADDRESS

Clarkston, MI 48346  
CITY, STATE, ZIP CODE

The undersigned Bidder, having examined the Drawings, Specifications, and related documents, and the site of the proposed Work, and being familiar with all the conditions surrounding the construction of the proposed Project including the availability of materials and labor, hereby proposes to furnish all labor, materials (not provided by owner), equipment, tools and services to construct the Project in accordance with the Contract Documents, within the time set forth therein, and at the prices stated below. These prices are to cover all expenses incurred in performing the Work required under the Contract Documents, of which this Proposal is a part, for the construction of the Project identified as follows:

Job No. NFE-M383-01 Contract No. \_\_\_\_\_

Job Title: INDEPENDENCE TOWNSHIP  
BAY COURT PARK MAINTENANCE GARAGE  
Located in Independence Township, Oakland County, Michigan.

all in accordance with the Drawings, Specifications, and other Contract Documents prepared by Nowak & Fraus Engineers, Consulting Engineers, Pontiac, Michigan.

PROPOSAL GUARANTY: The Proposal Guaranty in the form of a certified check drawn upon an open, solvent bank in good standing, or a bidder's bond for a sum of not less than five percent (5%) of the Proposal (Base Bid Amount Only), is furnished to the Owner as a guarantee on the part of the bidder that: (1) there are no errors in its bid, (2) all information submitted as part of its bid is true and accurate, and (3) that the bidder will, if called upon to do so, enter in to a contract in the attached form, to do the work covered by such proposal at the price stated therein and the Agreement will be executed and a Performance Bond, a Labor and Material Payment Bond, and a Maintenance Bond will be furnished within 10 days after award of the Contract to the undersigned Bidder.

WAIVER: The undersigned Bidder affirms: that he has sufficiently informed himself in all matters affecting the cost of the Work; that he has checked his Bid and this Proposal for errors and omissions; that the prices stated in this Proposal are as intended by him; and that the total Bid is a complete and correct statement of this price for doing all of the Work required by the Contract Documents. The undersigned Bidder does hereby waive any claim for the return of his Proposal Guaranty if, on account of errors or omissions claimed to have been made by him in his Bid or in this Proposal, or if for any other reason, he shall refuse or fail to execute the Contract or furnish the required bonds.

EXECUTION OF AGREEMENT AND FURNISHING BONDS: Within 10 days after being awarded the Contract, the undersigned agrees to execute the form of Agreement included as one of the Contract Documents, and to furnish a Performance Bond, a Labor and Material Payment Bond, and a Maintenance Bond, each in an amount equal to 100 percent of the Contract Amount (Base Bid Amount Only).

No special payments will be made to the Contractor for Work described in these Contract Documents unless a specific Item for such Work has been provided for in this Proposal. When Work to be performed is not specifically listed in this Proposal, such Work shall be considered incidental to the construction of the Project. The cost of such incidental Work shall, therefore, be considered to be included in the amount Bid for Items specifically listed.

The undersigned Bidder understands that the quantities of Work as shown herein are approximations. The undersigned Bidder offers to do the Work, whether the quantities are increased or decreased, at the Unit Prices or Lump Sum stated in the schedule on the following pages. The following project narrative is offered as explanation of the proposal format:

**BASE BID:** constitutes the Independence Township Bay Court Park Maintenance Garage Project, as detailed in the construction documents and specifications for construction. For the Project, the successful contractor will enter a contract with Independence Township, and all provisions of this document will apply.

Note, the provisions of the Base Bid - Independence Township Bay Court Maintenance Garage Project relative to Bid Bond, Performance Bond, Payment Bond, Maintenance Bond, and Insurance Requirements

Note, the undersigned Bidder understands that the Owner reserves the right to reject any or all Proposals or to waive any formality or technicality in any Proposal that serves the interest of the Owner.

The following is a summary of the Proposals unit pricing structure:

**BASE BID – BAY COURT PARK MAINTENANCE GARAGE**

| No. | Item Description                                | Unit | Total Quantity | Unit Price            | Bid Amount   |
|-----|---|------|----------------|-----------------------|--------------|
| 1.  | Mobilization, Max. 4%                           | LSUM | 1.00           | \$ _____              | \$ _____     |
| 2.  | Natural Gas – Service Costs Allowance           | DLR  | 41,000.00      | \$ 1.00               | \$ 41,000.00 |
| 3.  | Garage Building - Complete                      | LSUM | 1.00           | \$ _____              | \$ _____     |
| 4.  | Site Demolition                                 | LSUM | 1.00           | \$ _____              | \$ _____     |
| 5.  | Site Preparation/ Grading / Aggregate Placement | LSUM | 1.00           | \$ _____              | \$ _____     |
| 6.  | Project Restoration                             | LSUM | 1.00           | \$ _____              | \$ _____     |
| 7.  | Exterior Concrete                               | SFT  |                | \$ _____              | \$ _____     |
| 8.  | SESC Control Measures                           | LSUM | 1.00           | \$ _____              | \$ _____     |
|     |   |      |                |                       |              |
|     |   |      |                | <b>TOTAL BASE BID</b> | \$ _____     |

The undersigned Bidder hereby agrees to commence Work under this Contract within 10 calendar days after receipt of a written "Notice to Proceed" from the Owner. The Bidder further agrees to achieve Completion of the Work (Base Bid) no later than **May 3, 2024**. The date so determined will herein be referred to as the "Completion Date as Bid". Notice to Proceed date will be mutually agreed to between the Contractor and Owner.

As hereinafter provided in the General Conditions, the undersigned Bidder further agrees to pay the Owner, as liquidated damages, the sum of \$750.00 for each consecutive calendar day after the substantial completion the sum of \$750.00 for each consecutive calendar day after the "Completion Date" (as above determined), that the Project remains uncompleted. The undersigned Bidder agrees that this Proposal shall be good and may not be withdrawn for a period of 90 calendar days after the scheduled closing time for receipt of Bids.

The Owner agrees to furnish inspection of the project, at no cost to the Contractor, until the "Completion Date as Bid" After that date, the Contractor shall reimburse the owner, at the rate of \$900 per inspection-day, for each inspection-day that is furnished in accordance with Section 01.04.03 of Division 1 — GENERAL REQUIREMENTS.

The Owner agrees to furnish normal Construction Contract Administration (CCA) of the project, at no cost to the Contractor, until the "Completion Date as Bid" After that date - or before that date, if the CCA is abnormal - the Contractor shall reimburse the Owner, at the rate of \$500 per CCA-day, for each CCA-day that is furnished in accordance with Section 01.04.04 of DIVISION 1 - GENERAL REQUIREMENTS.

The undersigned Bidder agrees that this Proposal shall be good and may not be withdrawn for a period of 90 calendar days after the scheduled closing time for receipt of Bids.

The undersigned Bidder understands that the Owner reserves the right to reject any or all Proposals or to waive any formality or technicality in any Proposal that serves the interest of the Owner.

The undersigned Bidder hereby acknowledges receipt of the following Addenda:

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

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

THE ABOVE PROPOSAL IS HEREBY RESPECTFULLY SUBMITTED BY:

CONTRACTOR: \_\_\_\_\_, a duly organized:

\_\_\_\_ Proprietorship; \_\_\_\_ Partnership; or \_\_\_\_ Corporation authorized to do business in  
the Project state  
\_\_\_\_ Other (described as: \_\_\_\_\_)

BY: \_\_\_\_\_  
(signature) (title)  
\_\_\_\_\_  
(print name of signer) (date)  
\_\_\_\_\_  
(address) (city & state) (zip code)

Telephone No. (\_\_\_\_) \_\_\_\_\_ Federal Employer ID No. \_\_\_\_\_

NOTE: Bidder, if other than an individual (proprietorship), shall cause the following Certificate to be executed:

#### CERTIFICATE

I, \_\_\_\_\_, certify that I am a duly authorized \_\_\_\_\_  
of \_\_\_\_\_, and do certify that the following named persons:

1. \_\_\_\_\_  
(name) (title)
2. \_\_\_\_\_  
(name) (title)
3. \_\_\_\_\_  
(name) (title)
4. \_\_\_\_\_  
(name) (title)

are authorized to sign the Proposal, the Agreement, the Contract Bonds, and all other Contract Documents related to this Contract on behalf of and for said company.

BY: \_\_\_\_\_  
(signature) (title)

BY: \_\_\_\_\_  
(signature) (title)

## BID BOND

|  |  |
|--|--|
| OWNER<br><b>Charter Township of Independence</b> | CONTRACT IDENTIFICATION NUMBER<br><b>NFE-M383-01</b> |
|--|--|

|  |  |
|--|--|
| ADDRESS<br><b>6483 Waldon Center Drive, Clarkston MI 48346</b> |  |
|--|--|

|            |             |
|------------|-------------|
| CONTRACTOR | DATE OF BID |
|------------|-------------|

|         |  |
|---------|--|
| ADDRESS |  |
|---------|--|

|        |                    |
|--------|--------------------|
| SURETY | DATE BOND EXECUTED |
|--------|--------------------|

|         |  |
|---------|--|
| ADDRESS |  |
|---------|--|

|   |  |
|---|--|
| AMOUNT OF (express in words and figures) BOND |  |
|---|--|

WHEREAS, the Principal above-named has submitted to the Owner a proposal or bid, dated as shown above, on the above-numbered Contract. NOW, THEREFORE, we, the Principal and Surety, bind ourselves to the Owner in the amount of the bond stated above, that if the above Proposal is accepted, the Principal will promptly enter into contract in accordance with the Proposal and the Surety will furnish the required bonds, otherwise the Principal and/or Surety will pay the amount stated above unto the Owner as liquidated damages. This Bond to remain in full force and effect until the Contract is awarded and executed.

|               |                      |
|---------------|----------------------|
| Witnessed by: | CONTRACTOR PRINCIPAL |
| _____         | By _____             |
| _____         | Title _____          |

If the Contractor is other than an individual (proprietorship), the following certification must be executed.

I certify that I am the \_\_\_\_\_ company named as Contractor Principal in the within bond, that \_\_\_\_\_ who signed the said bond on behalf of the principal, was authorized to do so for and in behalf of said company.

|               |                  |
|---------------|------------------|
| Witnessed by: | CORPORATE SURETY |
|---------------|------------------|

|       |             |
|-------|-------------|
| _____ | By: _____   |
| _____ | Title _____ |

|             |               |
|-------------|---------------|
| LOCAL AGENT | AGENT'S PHONE |
|-------------|---------------|

## PERFORMANCE BOND

CONTRACT IDENTIFICATION NUMBER – NFE – M383-01

KNOW ALL MEN BY THESE PRESENTS: That \_\_\_\_\_, as Principal, and \_\_\_\_\_, as Surety, are held and firmly bound unto the Charter Township of Independence Township (hereinafter called Township), in the amount of \$ \_\_\_\_\_ for the payment of which Principal and Surety bind themselves, their heirs, executors, administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Township has approved the award of a Contract to Principal for the project known as INDEPENDENCE TOWNSHIP BAY COURT PARK – MAINTENANCE GARAGE, conditioned on Principal providing this Performance Bond, which Contract upon being fully signed, shall by reference be automatically made a part hereof and is referred to as the "Contract".

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is that, if Principal shall faithfully perform the contract according to all conditions, stipulations and specifications contained in the contract documents, and complete the construction free and clear of all liens and or claims of every description, and satisfy all claims and demands incurred, and shall fully indemnify and save harmless the Township from all liability and damages of every kind which it may suffer by reason of the Principal's performance under the contract, then this obligation shall be void and of no effect; otherwise it shall remain in full force and effect.

The Bond is given upon the express condition that any changes, alterations or modifications of the Contract; the extension of time; or the placing of an inspector or engineer on site by the Township in accordance with the provisions of the Contract, shall not operate in any way to release the Principal and Sureties.

Upon Principal's default in one or more obligations under the Contract and failure to cure the default in response to notices to the Principal and Surety by the Township, resulting in the Township exercising or having the right to exercise an option to perform some or all of the work required of Principal by the Contract, and the Township notifying Principal and Surety to pay Township an amount of money up to the amount of this Bond that is documented by Township as being the cost it has or will incur in performing Principal's obligations, Surety agrees to deliver the required payment to the Township within thirty (30) days. The Township payment notice shall be sent by registered mail.

In the event Principal takes any act to cancel, replace, modify or alter this Bond without prior consent of the Township, Surety shall provide immediate notice to the Township.



This Bond is given in compliance with and subject to all provisions and conditions of Public Act 213 of 1963; MCL 129.201 et.seq.

PRINCIPAL,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
*(See attached notarization of signature)*

SURETY,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
*(See attached notarization of signature)*

PAYMENT BOND: LABOR AND MATERIAL

CONTRACT IDENTIFICATION NUMBER – NFE – M383-01

KNOW ALL MEN BY THESE PRESENTS: That \_\_\_\_\_, as Principal,  
And \_\_\_\_\_, as Surety, are held and firmly bound unto the Charter  
Township of Independence Township (hereinafter called Township), in the amount of \$ \_\_\_\_\_  
for the payment of which Principal and Surety bind themselves, their heirs, executors,  
administrators, successors and assigns, jointly and severally, firmly by these presents.

WHEREAS, the Township has approved the award of a Contract to Principal for the project known  
as INDEPENDENCE TOWNSHIP BAY COURT PARK – MAINTENANCE GARAGE, conditioned  
on Principal providing this Payment Bond, which Contract upon being fully signed, shall by  
reference be automatically made a part hereof and is referred to as the "Contract".

NOW, THEREFORE, THE CONDITION OF THIS OBLIGATION is that, if Principal shall pay all  
persons that furnish labor, supplies, equipment and/or materials used or reasonably required for  
use in the performance of the Contract (Claimants), this obligation shall be null and void.  
Otherwise it shall remain in full force and effect.

Surety's obligation to pay a Claimant under this Payment Bond is conditioned on the Claimant  
providing notice of, perfecting and prosecuting its claim in compliance with the requirements of  
Michigan Public Act No. 213 of 1963, as amended, and other applicable Michigan law.

In the event Principal takes any act to cancel, replace, modify or alter this Bond without prior  
consent of the Township, Surety shall provide immediate notice to the Township.

PRINCIPAL,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
(See attached notarization of signature)

SURETY,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
(See attached notarization of signature)

## MAINTENANCE AND GUARANTEE BOND

### CONTRACT IDENTIFICATION NUMBER – NFE – M383-01

That \_\_\_\_\_ “Principal”, and \_\_\_\_\_ “Surety”, are held and firmly bound unto the Charter Township of Independence, “Township”, in the amount of \$\_\_\_\_\_, for which payment we bind ourselves, our heirs, executors, administrators, successors, and assigns, jointly and severally.

The Principal and the Township have entered into a written contract for a project known as INDEPENDENCE TOWNSHIP BAY COURT PARK – MAINTENANCE GARAGE.

Pursuant to the Contract and as required by the Township Ordinance, the Principal, guaranteed and warranted the workmanship and materials for each project performed under the Contract for a period of two (2) year(s) from the date of final payment for contract work and that any defects would be immediately corrected by repair or replacement as directed by and without additional cost or expense to the Township.

If the Principal does not correct defects reported in writing by the Township to the Principal and Surety by repair or replacement as directed by the Township within the time required, which shall not be less than one week from service of the notice, the Township shall have the right to perform or secure the performance of the corrections, with all costs and expenses in doing so, including an administrative fee equal to twenty-five percent (25%) of the repair costs, charged to and to be received from the Principal. In the event the Principal does not make payment on the costs charged within 30 days of Notice being sent, the Surety shall pay the amount charged directly to the Township.

Emergency repairs that are necessary to protect life and property may be undertaken by the Township immediately and without advance notice to the Principal and Surety, with the cost and expense of the repair, plus the administrative fee, to be charged to and received from the Principal. In the event the Principal does not make payment on the costs charged within 30 days of Notice being sent, the Surety shall pay the amount charged directly to the Township.

Any repairs the Township may perform as provided in this Bond may be by Township employees, agents, or independent contractors. The Township shall not be required to utilize competitive bidding unless otherwise required by applicable law, with labor cost and expense charges when Township employees are utilized to be based on the hourly cost to the Township of the employee(s) performing the repair.

It is a further condition of this Bond that the Principal and Surety shall fully indemnify, defend, and hold the Township, its agents and others working on the Township's behalf, harmless from all claims for damages or injuries to persons or property arising from or related to defects in work or materials, the correction of which are covered and guaranteed by this Bond, including claims arising under the worker's compensation laws of the State of Michigan.

PRINCIPAL,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
(See attached notarization of signature)

SURETY,

\_\_\_\_\_  
Dated

\_\_\_\_\_  
(See attached notarization of signature)

# SAMPLE

| CERTIFICATE OF INSURANCE   |  |   |   |                                   |                               | ISSUE DATE (MM/DD/YY)<br>00/00/00  |                 |           |
|--|--|---|---|-----------------------------------|-------------------------------|--|-----------------|-----------|
| <b>PRODUCER</b><br><br>ABC Insurance Agency<br>123 Main Street<br>Somewhere, U.S.A.  |  |   | THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. |                                   |                               |  |                 |           |
| <b>INSURED</b><br><br>DEF Contracting Company<br>456 Main Street<br>Anytown, U.S.A.  |  |   | <b>COMPANIES AFFORDING COVERAGE</b>   |                                   |                               |  |                 |           |
|  |  |   | COMPANY LETTER <b>A</b> XYZ Insurance Company   |                                   |                               |  |                 |           |
|  |  |   | COMPANY LETTER <b>B</b>   |                                   |                               |  |                 |           |
|  |  |   | COMPANY LETTER <b>C</b>   |                                   |                               |  |                 |           |
|  |  |   | COMPANY LETTER <b>D</b>   |                                   |                               |  |                 |           |
| COMPANY LETTER <b>E</b>  |  |   |   |                                   |                               |  |                 |           |
| <b>COVERAGES</b>   |  |   |   |                                   |                               |  |                 |           |
| THIS IS TO CERTIFY THAT POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED. NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN. THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. |  |   |   |                                   |                               |  |                 |           |
| CO LTR   | TYPE OF INSURANCE                              | POLICY NUMBER                           | POLICY EFFECTIVE DATE (MM/DD/YY)  | POLICY EXPIRATION DATE (MM/DD/YY) | LIABILITY LIMITS IN THOUSANDS |  |                 |           |
| <b>A</b>   | <b>GENERAL LIABILITY</b>                       |   | 123456  | 00/00/00                          | 00/00/00                      |  | EACH OCCURRENCE | AGGREGATE |
|  | <input checked="" type="checkbox"/>            | COMPREHENSIVE FORM                      |   |                                   |                               | BODILY INJURY  | \$1,000         | \$2,000   |
|  | <input checked="" type="checkbox"/>            | PREMISES/OPERATIONS                     |   |                                   |                               | PROPERTY DAMAGE  | \$1,000         | \$2,000   |
|  | <input checked="" type="checkbox"/>            | UNDERGROUND EXPLOSION & COLLAPSE HAZARD |   |                                   |                               | BI & PD COMBINED   | \$1,000         | \$2,000   |
|  | <input checked="" type="checkbox"/>            | PRODUCTS/COMPLETED OPERATIONS           |   |                                   |                               | PERSONAL INJURY  |                 | \$1,000   |
|  | <input checked="" type="checkbox"/>            | CONTRACTUAL                             |   |                                   |                               |  |                 |           |
|  | <input checked="" type="checkbox"/>            | INDEPENDENT CONTRACTORS                 |   |                                   |                               |  |                 |           |
|  | <input checked="" type="checkbox"/>            | BROAD FORM PROPERTY DAMAGE              |   |                                   |                               |  |                 |           |
|  | <input checked="" type="checkbox"/>            | PERSONAL INJURY                         |   |                                   |                               |  |                 |           |
| <input checked="" type="checkbox"/>  | <u>B.F.C.G.I</u>                               |   |   |                                   |                               |  |                 |           |
| <b>B</b>   | <b>AUTOMOBILE LIABILITY</b>                    |   | 123456  | 00/00/00                          | 00/00/00                      | BODILY INJURY (PER PERSON)   | \$2,000         |           |
|  | <input checked="" type="checkbox"/>            | ANY AUTO                                |   |                                   |                               | BODILY INJURY (PER ACCIDENT)   | \$2,000         |           |
|  | <input checked="" type="checkbox"/>            | ALL OWNED AUTOS (PRIV PASS)             |   |                                   |                               | PROPERTY DAMAGE  | \$2,000         |           |
|  | <input checked="" type="checkbox"/>            | ALL OWNED AUTOS (OTHER THAN PRIV PASS)  |   |                                   |                               | BI & PD COMBINED   | \$2,000         |           |
|  | <input checked="" type="checkbox"/>            | HIRE AUTOS                              |   |                                   |                               |  |                 |           |
|  | <input checked="" type="checkbox"/>            | NON-OWNED AUTOS                         |   |                                   |                               |  |                 |           |
|  | <input checked="" type="checkbox"/>            | GARAGE LIABILITY                        |   |                                   |                               |  |                 |           |
| <b>C</b>   | <b>EXCESS LIABILITY</b>                        |   | 123456  | 00/00/00                          | 00/00/00                      | BI & PD COMBINED   | \$2,000         | \$2,000   |
|  | <input checked="" type="checkbox"/>            | UMBRELLA FORM                           |   |                                   |                               |  |                 |           |
| <b>D</b>   | WORKERS' COMPENSATION AND EMPLOYEES' LIABILITY |   | 123456  | 00/00/00                          | 00/00/00                      | STATUTORY<br><div style="display: flex; justify-content: space-between; font-size: small;"> <span>\$100 (EACH ACCIDENT)</span> <span>\$100 (DISEASE-POLICY LIMIT))</span> </div> <div style="display: flex; justify-content: space-between; font-size: small;"> <span>\$500 (DISEASE-EACH EMPLOYEE))</span> </div> |                 |           |
| <b>DESCRIPTION OF OPERATIONS/LOCATIONS/VEHICLES/SPECIAL ITEMS</b><br>ADDITIONAL INSURED: CHARTER TOWNSHIP OF INDEPENDENCE , ITS AGENTS, EMPLOYEES, ELECTED OFFICIALS, VOLUNTEERS, AND ALL BOARDS, COMMISSIONS AND AUTHORITIES WITHIN THE OPERATING BUDGETS OF THE CHARTER TOWNSHIP OF INDEPENDENCE , NFE ENGINEERS; AS RESPECTS JOB: M383-01   |  |   |   |                                   |                               |  |                 |           |
| <b>CERTIFICATE HOLDER</b>  |  |   | <b>CANCELLATION</b>   |                                   |                               |  |                 |           |
| Charter Township of Independence<br>6483 Waldon Center Road<br>Clarkston, MI 48346   |  |   | SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF. THE ISSUING COMPANY WILL MAIL <u>30</u> DAYS WRITTEN NOTICE TO THE CERTIFICATE HOLDER NAMED TO THE LEFT.        |                                   |                               |  |                 |           |
|  |  |   | AUTHORIZED REPRESENTATIVE   |                                   |                               |  |                 |           |
|  |  |   | John Doe ( <i>signature</i> )   |                                   |                               |  |                 |           |

## AGREEMENT

ARTICLES OF AGREEMENT, made and entered into this \_\_\_\_\_ day of \_\_\_\_\_

by and between \_\_\_\_\_ of \_\_\_\_\_, hereinafter called the Contractor,  
(Contractor) (City and State)

and Charter Township of Independence of Clarkston, Michigan  
(Owner) (City and State)

hereinafter called the Owner; WITNESSETH, that the Contractor and the Owner for the considerations hereinafter named agree as follows:

1. That all Contract Documents (as defined in the "General Provisions" of the Specifications) herein attached or herein referred to for the Project identified below, shall be and are hereby made a part of this Contract.

Job No. NFE-M383-01 Contract No. \_\_\_\_\_

Job Title: INDEPENDENCE TOWNSHIP  
BAY COURT PARK – MAINTENANCE GARAGE

For which the Gross Proposal Amount is \$ \_\_\_\_\_

2. The Contractor shall furnish all labor, materials, equipment, tools, and services necessary to construct the Project, as set forth in his Proposal and the General Provisions, in strict accordance with the Contract Documents in the manner, time, and place as therein set forth and that for all parts of the Project, no less than the minimum salaries and wages must be paid on this Project as required by the Minimum Wage Act of 1964, as amended, MCL §408.381, et seq, and that the Contractor must ensure that employees and applicants for employment are not discriminated against because of their race, color, religion, sex or national origin, in accordance with the Elliott-Larsen Civil Rights Act, MCL §37.2101, et seq.
3. In consideration whereof, the Owner agrees to pay to the Contractor the amounts provided in the attached Proposal, being either a Lump Sum or the projection of the Unit Prices therein set forth, multiplied by the number of units actually constructed, all in the time and manner as set forth in Section B.12 of the "General Provisions."
4. IN WITNESS whereof, said parties have hereon set their hands and seals the day and year first above written.

Contractor \_\_\_\_\_

\_\_\_\_\_  
By \_\_\_\_\_ Title

By \_\_\_\_\_ Title

Owner Charter Township of Independence

\_\_\_\_\_  
By \_\_\_\_\_ Title

By \_\_\_\_\_ Title

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## DIVISION B - GENERAL PROVISIONS

### B.01 DEFINITIONS

Whenever used in the Contract Documents, the following terms shall have the meanings indicated, which shall be applicable to both the singular and plural thereof:

- ACT OF GOD: An earthquake, cyclone, or other cataclysmic phenomenon of nature. Rain, wind, flood, or other natural phenomenon of normal intensity for the locality shall not be construed as an Act of God and no representation shall be made to the Contractor for damages to the Work resulting therefrom.
- ADDENDA: Written or graphic instruments issued prior to the execution of the Agreement which modify or interpret the Contract Documents, Drawings, and Specifications, by additions, deletions, clarifications, or corrections.
- AGREEMENT: The page executed by the Owner and Contractor covering the performance of the Work described in the Contract Documents.
- BID: The offer or Proposal of a Bidder to perform the work described in the Contract Documents when made out and submitted on the prescribed proposal forms setting forth the prices for the work to be performed, properly signed and guaranteed. Also referred to as "Proposal."
- BIDDER: Any person, firm, or corporation submitting a Bid for the Work.
- BONDS: Bid Bond, Performance Bond, Labor and Material, Payment Bond, Maintenance Bond, and other instruments of security, furnished by the Contractor and his Surety in accordance with the Contract Documents.
- CHANGE ORDER: A written amendment of the Contract between the Owner and the Contractor authorizing an addition, deletion, or revision in the Work within the general scope of the Contract Documents, or authorizing an adjustment in the Contract Price or Contract Time.
- CONTRACT AMOUNT (CONTRACT PRICE): The total monies payable to the Contractor under the terms and conditions of these Contract Documents.
- CONTRACT DOCUMENTS: The Contract, including Advertisement, Instructions to Bidders, Supplemental Instructions to Bidders, Proposal, Agreement Page, Bonds, Certificate of Insurance, Contractor's Declaration, General Provisions, Supplemental General Provisions, Construction Specifications, Supplemental Specifications, Drawings, Addenda, Notice of Award, Notice to Proceed, and Change Orders.
- CONTRACT TIME: The number of calendar days stated in the Proposal for the completion of the Work.
- CONTRACTOR: The person, firm, or corporation with whom the Owner has executed the Agreement.
- DRAWINGS: The part of the Contract Documents which show the characteristics and scope of the Work to be performed and which have been prepared or approved by the Engineer.
- ENGINEER: As named in the Proposal or in the Supplemental Specifications.

- FIELD ORDER: Written directives issued by the Engineer, as authorized by the Owner, to the Contractor. Field Orders may take the form of instructions or authorizations in reference to performance of the Work. Field Orders may also be interpretations or clarifications of the Contract Documents. Field Orders do not change the content, nor shall they be interpreted as a change in the Contract Documents.
- GOVERNING AGENCY: Public authority (state, county, township, or other public agency) or their boards, commissions, departments, etc. which has statutory ownership or control of the referred to facility or area.
- GROSS PROPOSAL AMOUNT: The total sum of all of the amounts obtained by extending the Contractor's Bid Prices times the Engineer's Estimated Quantities; on Lump Sum Contracts, the Lump Sum Amount Bid.
- INCIDENTAL TO THE PROJECT: Incidental items of Work required but not specifically listed in the Proposal and for which no separate payment will be made. The costs associated with such incidental items are to be included in the Prices Bid for Items of Work specifically listed in the Proposal and included in the Gross Proposal Amount.
- INCIDENTAL TO ITEM (AS DESIGNATED): Incidental items of Work required but not specifically listed in the Proposal and for which no separate payment will be made. The costs associated with such Work are to be included in the Price Bid for the specific Item so designated.
- NOTICE OF AWARD: The written notice of the acceptance of the Bid from the Owner to the successful Bidder.
- NOTICE TO PROCEED: Written communication issued by the Owner to the Contractor authorizing him to proceed with the Work and establishing the commencement date and completion date for the Work.
- OWNER: A public or quasi-public body or authority, corporation, association, partnership, or individual for whom the Work is to be performed.
- OWNER'S AGENT: A duly appointed representative delegated by the Owner to perform as his Agent in the administration of the Work. If an Owner's Agent has been appointed, all business conducted by an Owner's Agent shall be in the best interest of the Owner and shall be as if conducted by the Owner.
- OWNER'S REPRESENTATIVE: A duly appointed representative of the Owner delegated to assist in the administration of the Contract.
- PLANS: The Drawings as prepared by the Engineer which show the characteristics and scope of the Work to be performed and which are a part of the Contract Documents.
- PROJECT: The undertaking to be performed as provided in the Contract Documents.
- PROPOSAL: The offer of a Bidder to perform the Work described in the Contract Documents when made out and submitted on the prescribed proposal forms, setting forth the prices for the work to be performed, properly signed and guaranteed. Also referred to as "Bid".
- PROPOSAL GUARANTY: The cashier's check, certified check, or Bid Bond accompanying the Proposal submitted by a Bidder as a guarantee that the Bidder will enter into an agreement with the Owner for construction of the Work if the Contract is awarded to him.

- PUNCH LIST: A list of uncompleted work given to the Contractor by the Engineer.
- SHOP DRAWINGS: All drawings, diagrams, illustrations, brochures, schedules, and other data prepared by the Contractor, a Subcontractor, manufacturer, Supplier, or distributor, which illustrate how specific portions of the Work shall be fabricated or installed.
- SPECIFICATIONS: A part of the Contract Documents consisting of written descriptions of a technical nature of materials, equipment, construction systems, standards, and workmanship.
- SUBCONTRACTOR: An individual, firm, or corporation having a direct contract with the Contractor, or with another Subcontractor, for the construction of a part of the project.
- SUBSTANTIAL COMPLETION DATE: That date as certified by the Engineer when the construction of the Project, or a specified part thereof, is sufficiently completed, in accordance with the Contract Documents, so that the Project or specified part can be utilized for the purposes for which it is intended.
- SUPPLEMENTAL GENERAL PROVISIONS AND SUPPLEMENTAL INSTRUCTIONS TO BIDDERS: Modifications to General Provisions and Instructions to Bidders required by a federal or state agency for participation in the Project and approved by the agency in writing prior to inclusion in the Contract Documents, or such requirements that may be imposed by applicable State laws.
- SUPPLIER: Any person or organization who supplies materials or equipment for the Work, including that fabricated to a special design, but who does not perform labor at the site.
- SURETY: The corporation that executes the Contractor's Bid Bond, Performance Bond, Labor and Material Payment Bond, or Maintenance Bond.
- WORK: All labor necessary to produce the construction required by the Contract Documents, and all materials and equipment incorporated or to be incorporated in the Project.
- WRITTEN NOTICE: Any notice to any party of the Agreement relative to any part of this Agreement in writing and considered delivered and the service thereof completed, when delivered or posted by certified or registered mail to the said party at his last given address or delivered in person to said party or his authorized representative on the Work.

## B.02 ABBREVIATIONS

The following abbreviations, as used in the Contract Documents, have the listed meanings:

AAN ..... American Association of Nurserymen, Inc.  
AAR ..... Association of American Railroads  
AASHTO ..... American Association of State Highway and Transportation Officials  
AC ..... Alternating Current, Acres  
ACI ..... American Concrete Institute  
AGA ..... American Gas Association  
AGC ..... The Associated General Contractors of America, Inc.  
AIA ..... American Institute of Architects  
AISC ..... American Institute of Steel Construction  
AISI ..... American Iron and Steel Institute  
ANSI ..... American National Standards Institute  
APHA ..... American Public Health Association

|                |   |
|----------------|---|
| API .....      | American Petroleum Institute  |
| APWA .....     | American Public Works Association   |
| ARBA .....     | American Road Builders' Association                                       |
| AREA .....     | American Railway Engineering Association                                  |
| ARI. ....      | Air Conditioning and Refrigeration Institute                              |
| ASCE .....     | American Society of Civil Engineers                                       |
| ASHRAE .....   | American Society of Heating, Refrigerating and Air Conditioning Engineers |
| ASLA .....     | American Society of Landscape Architects                                  |
| ASME .....     | American Society of Mechanical Engineers                                  |
| ASTM .....     | American Society for Testing and Materials                                |
| AUC .....      | Associated Underground Contractors, Inc.                                  |
| AWG .....      | American Wire Gauge   |
| AWWA .....     | American Water Works Association  |
| BOCA.....      | Building Officials Conference of America, Inc.                            |
| BTU.....       | British Thermal Unit  |
| C .....        | Centigrade, Celsius   |
| CF .....       | Cubic Foot, Feet  |
| CFS.....       | Cubic Feet per Second   |
| CPCO .....     | Consumers Power Company   |
| CRSI .....     | Concrete Reinforcing Steel Institute                                      |
| CSI.....       | Construction Specification Institute                                      |
| CY .....       | Cubic Yards   |
| DC.....        | Direct Current  |
| DE.....        | The Detroit Edison Company  |
| DNR .....      | Department of Natural Resources   |
| DWSD.....      | Detroit Water and Sewerage Department                                     |
| EA .....       | Each  |
| EEI .....      | Edison Electric Institute   |
| EPA.....       | Environmental Protection Agency   |
| F .....        | Fahrenheit  |
| FOB .....      | Free on Board   |
| FT.....        | Feet  |
| GPM.....       | Gallons per Minute  |
| HP .....       | Horsepower  |
| (DENT .....    | Identification  |
| IEEE.....      | Institute of Electrical and Electronic Engineers                          |
| IES .....      | Illuminating Engineering Society  |
| IN .....       | Inches  |
| ISA .....      | Instrument Society of America   |
| KVA.....       | Kilovolt-Ampere   |
| LBS .....      | Pounds  |
| LF.....        | Lineal Feet   |
| LS.....        | Lump Sum  |
| MBT .....      | Michigan Bell Telephone Company   |
| MCRC .....     | Macomb County Road Commission   |
| MDPH .....     | Michigan Department of Public Health                                      |
| MDOT or SHD .. | Michigan Department of Transportation or State Highway Department         |
| NBBPVI.....    | National Board of Boiler and Pressure Vessel Inspectors                   |
| NBS. ....      | National Bureau of Standards  |
| NCPI .....     | National Clay Pipe Institute  |
| NCPWB .....    | National Certified Pipe Welding Bureau                                    |
| NEC .....      | National Electric Code  |
| NEMA.....      | National Electrical Manufacturers Association                             |

NFPA ..... National Fire Protection Association  
 OPWC/MC ..... Office of the Public Works Commissioner, Macomb County  
 OSHA ..... Occupation Safety and Health Administration  
 PSI ..... Pounds per Square Inch  
 REF ..... Reference  
 SAE ..... Society of Automotive Engineers  
 SF ..... Square Feet  
 SMSD ..... South Macomb Sanitary District  
 SPEC ..... Specification  
 SPI ..... Society of the Plastic Industry, Inc.  
 SSPC ..... Steel Structures Painting Council  
 SY ..... Square Yards  
 T ..... Tons  
 TGU ..... Thousand Gallon Unit  
 UBC ..... Uniform Building Code  
 UL ..... Underwriters Laboratory  
 WPCF ..... Water Pollution Control Federation  
 USCGS ..... United States Coast and Geodetic Survey  
 USGS ..... United States Geological Survey

### B.03 DRAWINGS, SPECIFICATIONS, AND RELATED DATA

#### B.03.01 Intent of Drawings and Specifications

The intent of the Drawings and Specifications is that the Contractor furnish all labor, materials, equipment, and transportation necessary for the proper execution of the Work unless specifically noted otherwise. The Contractor shall do all the Work shown on the Drawings and described in the Specifications and all incidental Work considered necessary to fully complete the Project in a substantial and acceptable manner ready for use, occupancy, and operation by the Owner.

#### B.03.02 Adequacy of Drawings and Specifications

Responsibility to Contractor for inadequacy of the design and for insufficiency of the Drawings and Specifications shall be borne by the Owner, subject to Owner's recourse against Engineer for all such inadequacies or insufficiencies. The complete requirements of the Work to be performed under the Contract shall be set forth in Drawings and Specifications to be supplied by the Owner through the Engineer or by the Engineer as representative of the Owner. Drawings and Specifications furnished shall be in accordance with the Contract Documents and shall be true and accurate developments thereof. All information concerning utilities shown on the Drawings were obtained using the best information available. No guarantee is given or implied that the information or the location as shown is absolutely correct, or that other facilities, in addition to those shown, are not present and may be encountered.

#### B.03.03 Dimensions

Figured dimensions on the Drawings will be used in preference to scaling the Drawings. Where dimensions are not shown on the Drawings and are required for the Contractor to properly construct the Work, he shall obtain such dimensions from the Engineer.

#### B.03.04 Conflicts

If there are conflicts among the Supplemental Specifications, the Drawings, and/or the Detailed Specifications, the Supplemental Specifications shall govern over both the Drawings and the Detailed Specifications; and the Drawings shall govern over the Detailed Specifications.

#### B.03.05 Discrepancies in Drawings and Specifications

Any discrepancies found between the Drawings and Specifications and site conditions or any errors or omissions in the Drawings or Specifications shall be immediately reported to the Engineer, who shall promptly correct such error or omission in writing. Any Work done by the Contractor after his discovery of such discrepancies, errors, or omissions shall be done at the Contractor's risk.

#### B.03.06 Specifications by Reference

Where reference is made in the Specifications to specifications or standards of any technical society, association, governmental agency, etc., it is understood and agreed that the latest edition (unless otherwise stated) of such specifications or standards are a part of the Specifications as though fully repeated therein. In interpreting any specification or standard referred to, terms such as "Purchaser," "Owner," and the like shall be understood to mean the person or organization designated as the Owner in the Contract, acting by and through its duly constituted legislative body. Terms such as "Manufacturer," "Supplier," and the like shall mean the Contractor.

It is also understood and agreed that the use or application of any specification or standard referred to shall not necessarily be restricted to that which may be named in the title or the specification or standard, but shall be used or applied as set forth in these Specifications.

The Contractor shall secure copies of standards and specifications referred to herein. A copy of each specification or standard referred to is on file in the Engineer's office; however, it is assumed that a qualified Contractor experienced in the type of Work involved will have access to the specifications or standards referred to.

#### B.03.07 Copies of Drawings and Specifications

Except as provided for otherwise, all copies of Drawings and Specifications reasonably necessary for the execution of the Work shall be furnished to the Contractor without charge.

#### B.03.08 Drawings and Specifications at the Project Site

One complete set of all Drawings and Specifications shall be maintained at the job site and shall be available to the Engineer at all times.

#### B.03.09 Ownership of Drawings and Specifications

All original or duplicated Drawings and Specifications and other data prepared by the Engineer shall remain the property of the Owner and Engineer, shall not be copied or reused by Contractor on other Work, and shall be returned to the Owner or Engineer upon completion of the Work upon demand.

#### B.03.10 Additional Instructions and Detailed Drawings

Further instructions may be issued by the Engineer during the progress of the Work by means of Drawings or otherwise to make more clear or specific the Drawings and Specifications or as may be necessary to explain or illustrate changes in the Work to be done. Moreover, the Contractor shall attend a preconstruction meeting, at a time and place as arranged by the Owner, at which time various utility companies and governmental agency representatives will be present.

#### B.03.11 Physical Conditions Ordinarily Encountered and Inherent in the Work to be Performed

Contractor agrees and stipulates that following physical conditions may exist at the site and are of a nature ordinarily encountered and generally recognized as inherent in the work to be performed:

- a. Groundwater and soil conditions such that the utilization of dewatering equipment up to and including trench boxes, well points and deep wells as well as additional backfill to support structures may be required.
- b. Trees and other vegetation requiring special care to avoid damage.
- c. Public utilities whose exact location is unknown from plans, including gas, water, electric, sanitary and storm sewer facilities.

#### B.04 LIMITATION OF LIABILITY, INDEMNIFICATION, AND INSURANCE

##### B.04.01 Limitation of Liability

The Contractor affirmatively represents that he is skilled and experienced in the use and interpretation of Drawings and Specifications such as those included in the Bid Documents of this Contract. Further, he also affirmatively represents that he has carefully reviewed the Drawings and Specifications of this Contract and that he has based his Bid solely on these Documents, not relying in any way on any explanation or interpretation -- oral or written -- from any other source. Unless the Contractor shall give written notice to the Engineer of any ambiguities contained in the Drawings and Specifications prior to the submission of its Bid, the Contractor agrees that it shall be conclusively presumed that the Contractor has exercised his aforementioned skill and experience and found the Drawings and Specifications sufficient and free from ambiguities, errors, or omissions for the purpose of determining its Contract Bid Price for the performance of the Work in conformity with the Drawings and Specifications.

Submission of a Bid without prior written notice to the Engineer of any claimed ambiguities, errors, or omissions shall constitute a waiver of any and all bid-price-related claims by the Contractor that are based upon any alleged ambiguities, errors, omissions, or the like in the Drawings or Specifications.

##### B.04.02 Indemnification

The Contractor agrees to indemnify, defend, and save harmless the Owner and the Engineer, their consultants, agents, and employees, from and against all loss or expense (including costs and attorneys' fees) by reason of liability imposed by law upon the Owner and the Engineer,



their consultants, agents, and employees for damages because of bodily injury, including death at any time resulting therefrom, sustained by any person or persons or on account of damage to property, including loss of use thereof, arising out of or in consequence of the performance of this Work, whether such injuries to person or damage to property is due or claimed to be due to the negligence of the Contractor, his Subcontractors, the Owner, the Engineer, and their consultants, agents, and employees, except only such injury or damage as shall have been occasioned by the sole negligence of the Owner, the Engineer, and their agents and/or consultants.

#### B.04.03 Qualification of Insurance Companies

The Contractor shall provide certificates of all insurance required evidencing the required coverage at the time of the execution of the Contract. The policies shall name the Contractor as an insured and the Charter Township of Independence Township, its agents, employees, elected officials, volunteers, and all boards, commissions and authorities within the operating budgets of the Charter Township of Independence, Nowak & Fraus, PLLC, as respect to job: NFE - M383-01 as an additional insured.

All policies shall be endorsed to provide that the insurer shall give written notice to the Owner at least thirty (30) days in advance of any cancellation or expiration of the policy. The Contractor shall provide the Owner with written notice of any material change to any policy immediately upon receipt of notice of such material change. Upon request by the Owner, the Contractor shall provide copies of policies required by the Contract. In the event that the Contract is extended beyond its original term, the Contractor shall continue the required insurance coverage in effect during any extended term of the contract.

All insurance required under these Specifications shall be furnished by an insurance company qualified to do business in the state in which the Work is located and shall have a rating of A:V as listed in the latest issue of A.M. Best's "Key Rating Guide."

Certificates of Insurance shall be on the form of certificate included in these Specifications.

#### B.04.04 Workmen's Compensation and Employer's Liability Insurance

The Contractor shall procure and maintain in force during the life of this Contract Workmen's Compensation Insurance as required by the statutes of the state in which the Work is located for all his employees engaged in the Work connected with this Contract. If the Work involves maritime or railroad exposure which requires coverage under the Longshoreman's and Harbor Worker's Act or under the Maritime and Federal Employers' Liability Act, in lieu of or in addition to Workmen's Compensation coverage, the Workmen's Compensation policy shall be endorsed to provide such coverage. In addition, the Workmen's Compensation policy shall be endorsed to define the scope of coverage for the Contractor's corporate officers or partners if required by the Workmen's Compensation Law of the state in which the Work is located.

The Contractor shall also procure, and maintain in force during the life of this Contract, Employer's Liability Insurance in an amount not less than \$100,000.

Before starting the Work, the Contractor shall file with the Owner and the Engineer certificates of the above-described insurance, acceptable to the Owner.

#### B.04.05 Comprehensive General Liability Insurance

The Contractor shall procure and maintain during the life of this Contract Comprehensive General Liability Insurance to protect from claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees including claims insured by personal injury liability coverage and from claims for injury or destruction of tangible property including loss of use resulting therefrom -- any and all of which may arise out of or result from the Contractor's operations under the Contract whether such operations be by himself or by any Subcontractor or anyone directly or indirectly employed by any of them or for whose acts any of them may be Legally liable. Such insurance shall include coverage for:

- a. Operation and Premises
- b. Independent Contractor Protective Liability
- c. Completed Operation - Products Liability
- d. Contractual Liability
- e. Explosion, Collapse, or Underground Damage
- f. Broad Form Property Damage

The limits of liability for bodily injury including accidental death shall be \$1,000,000 per occurrence and a total limit of \$2,000,000 for all completed Operations-Products bodily injury claims during a single policy year.

The limits of liability for property damage shall be \$1,000,000 per occurrence and \$2,000,000 aggregate limit individually each for Operations, Independent Contractor Protective, and Contractual for each Project, and \$2,000,000 aggregate limit for Completed Operation - Products property damage during a single policy year.

Before starting the Work, the Contractor shall file with the Owner and the Engineer all required certificates of insurance, policies and endorsements," of the above described insurance, acceptable to the Owner.

In addition, the Contractor shall extend the above described Completed Operations-Products Liability insurance coverage to the end of the Contract Guaranty period and shall furnish the Owner a certificate of insurance to that effect for the entire Guaranty period prior to final payment for Work done under this Contract.

#### B.04.06 Comprehensive Motor Vehicle Liability Insurance

The Contractor shall procure and maintain during the life of this Contract Comprehensive Motor Vehicle Liability Insurance to a combined limit for bodily injury and property damage liability in the amount of \$2,000,000 per accident. The policy shall include coverage for owned, non-owned, and hired motor vehicles.

Before starting the Work, the Contractor shall file with the Owner and the Engineer all required certificates of insurance, policies and endorsements," of the above-described insurance acceptable to the Owner.

#### B.04.07 Umbrella Excess Liability Insurance

The Contractor shall procure and maintain during the life of the Contract, Umbrella Excess Liability Insurance in the single limit of at least \$2,000,000. This insurance shall cover all

insureds for at least all risks described in the Comprehensive General Liability and Comprehensive Motor Vehicle Liability policies.

Before starting the Work, the Contractor shall file with the Owner and the Engineer certificates of the above-described insurance acceptable to the Owner.

**B.04.08     Protective Public Liability Insurance**

**a.     Owners Protective Public Liability Insurance**

The Contractor shall procure and maintain during the life of the Contract Owners Protective Public Liability Insurance in the name of the Owner to protect against claims for damages because of bodily injury or death, and for property damage caused by the Contractor or his Subcontractors including coverage for costs of defense from all such claims. The limits of liability for bodily injury including death shall be \$2,000,000 per occurrence.

The limits of liability for property damage shall be \$1,000,000 per occurrence and \$2,000,000 aggregate limits.

The Owners Protective Public Liability Insurance Policy shall include as Additional Insureds the Engineer and his consultants, agents, and employees, and all public corporations in whose jurisdiction the Work is located.

Before starting the Work, the Contractor shall file with all Additional Insureds all required certificates of insurance, policies and endorsements,” of the policy for the above-described insurance acceptable to the Owner.

**b.     Railroad Protective Public Liability Insurance**

When the Contract Work includes construction crossing railroads, the Contractor shall procure and maintain during the life of the Contract Protective Public Liability Insurance in the name of the railroad to protect against claims for damages because of bodily injury or death and for property damage caused by the Contractor or his Subcontractors. The form of the policy and the amount of the liability coverage shall be determined by the railroads involved.

Before starting the Work, the Contractor shall file with each of the named insured and the Owner and the Engineer a copy of the policy for the above-described insurance acceptable to the railroad.

**B.04.09     All-Risk Builder's Risk Insurance (Required for Buildings Only)**

The Contractor shall procure and maintain in the name of the Owner and the Contractor, as their respective interests may appear during the life of the Contract, All-Risk Builder's Risk Insurance on a Completed Value Basis in an amount not less than the Contract Amount plus the value of all material furnished by parties other than the Contractor for installation in the Project, to cover all Project structures and materials, supplies, machinery, equipment, and fixtures including the installation cost thereof which are owned by the insured or for which the insured is legally liable. This policy covers the property of the insured (a) while in transit at the risk of the insured; (b) while on the premises of construction or installation awaiting use in the construction or awaiting the installation; (c) during construction, installation, or testing. This policy insures against all risk of direct physical loss or damage to the property insured hereunder and shall specially cover loss

due to Fire, Lightning, Vandalism, Malicious Mischief, Flood, Collapse, Windstorm, Hail, Explosion, Riot, Civil Commotion, Aircraft, Vehicles, Smoke and other "all risk" perils, but may be subject to exclusion of losses from wear and tear, misappropriation or other dishonest act by

insured, earthquake, interruption of business, defective materials, collapse due to faulty workmanship, war, nuclear reaction or radiation.

The All-Risk Builder's Risk Insurance Policy shall include the Engineer and his consultants, agents, and employees as additional named insured.

Before starting the Work, the Contractor shall file with all insured a copy of the policy for the above- described insurance acceptable to the Owner.

## B.05 CONTRACT BONDS

### B.05.01 Performance Bond

At the time of execution of the Agreement by the Owner, the Contractor shall furnish a Performance Bond in an amount equal to 100 percent of the Contract Amount. Only the form of bond enclosed or provided by the Owner will be acceptable. The Surety shall be authorized to do business in the state where the Work is located.

### B.05.02 Labor and Material Payment Bond

At the time of execution of the Agreement by the Owner, the Contractor shall furnish a Labor and Material Payment Bond in an amount equal to 100 percent of the Contract Amount. Only the form of bond enclosed or provided by the Owner will be acceptable. The Surety shall be authorized to do business in the state where the Work is located.

### B.05.03 Maintenance and Guarantee Bond

At the time of execution of the Agreement by the Owner, the Contractor shall furnish a Maintenance Bond in an amount equal to 100 percent of the Contract Amount. Only the form of bond enclosed or provided by the Owner will be acceptable. The Surety shall be authorized to do business in the state where the Work is located.

## B.06 ENGINEER-OWNER-CONTRACTOR RELATIONS AND AUTHORITIES

### B.06.01 Contractor's Responsibility and Authority

The Engineer shall maintain a competent and qualified Resident Project Representative (RPR) and assistants (the "RPR staff") at the Project site. Through more extensive on-site observations of the work in progress and field checks of materials and equipment by the RPR staff, the Engineer shall endeavor to provide further protection for the Owner against defects and deficiencies in the work of the Contractor. But the furnishing of such services shall, in no way, make the Engineer responsible for either (a) the quality of any of the work for which the Contractor is intended to be responsible or (b) for the Contractor's failure to perform the Work in accordance with the Construction Contract Documents.

The Contractor shall supervise and direct the Work efficiently and with his best skill and attention. He will be held solely responsible for the means, methods, techniques, sequences, and procedures of construction. The Contractor will be responsible for ensuring that the finished Work complies accurately with the Contract Documents.

The Contractor shall comply with the "Safety and Health Regulations for Construction" (and subsequent amendments) promulgated by the United States Department of Labor, identified as OSHA Safety and Health Standards General Industry Standards, and the current rules and regulations of the Michigan Occupational Safety and Health Act (MIOSHA) covering Safety and Health Standards for construction. These rules and regulations are incorporated by reference in these Contract Documents and all Work under this Contract shall be performed in compliance with them.

**B.06.02    Contractor's Superintendent**

A qualified superintendent who is acceptable to the Engineer shall be maintained on the Work site on a full time basis and shall give efficient supervision to the Work until its completion. The superintendent shall have full authority to act on behalf of the Contractor.

**B.06.03    Contractor's Right to Suspend Work or Terminate Contract**

The Contractor may suspend Work or terminate the Contract upon 10 days written notice to the Owner and the Engineer, for any of the following reasons:

- a. If an order of any court, or other public authority caused the Work to be stopped or suspended for a period of 6 months through no act or fault of the Contractor or his employees.
- b. If the Owner should fail to act on an Engineer's Certificate for Payment in the time and manner required by these General Provisions, as supplemented.

**B.06.04    Suspension of Work by Owner**

The Work or any portion thereof may be suspended at any time by the Owner for his convenience, provided that he gives the Contractor 5-days' written notice of said suspension. The Contractor shall resume the Work upon written notice from the Owner.

**B.06.05    Owner's Right to Correct Deficiencies**

Upon failure of the Contractor to perform the Work in accordance with the Contract Documents, including any requirements with respect to the Schedule of Completion, and after 5-days' written notice to the Contractor that includes a written statement of deficiencies from the Owner and/or Engineer, the Owner may, without prejudice to any other remedy he may have, correct such deficiencies.

**B.06.06    Owner's Right to Terminate Contract and Complete the Work**

In the event of any default by the Contractor the Owner shall have the right to terminate the employment of the Contractor after giving 10 days written notice of such termination to the Contractor. In the event of such termination, the Owner may take possession of the Work and of all materials, tools, and equipment thereon and may finish the Work by whatever method and means he may select. It shall be considered a default by the Contractor whenever he shall:

- a. Declare bankruptcy, become insolvent, or assign his assets for the benefit of his creditors.

- b. Disregard or violate provisions of the Contract Documents or Engineer's instructions, or fail to prosecute the Work according to the agreed Schedule of Completion, including extensions thereof.
- c. Fail to provide a qualified superintendent, competent workmen, competent Subcontractors, or proper materials, or fail to make prompt payment therefore.

**B.06.07    Authority of Owner's Agent**

No agent of the Owner shall have power to revoke, alter, enlarge, or relax the stipulations or requirements of the Specifications, except insofar as such authority may be specifically conferred by the Specifications themselves.

**B.06.08    Engineer's Responsibility and Authority**

Subject to Owner's approval, the Engineer shall decide any and all questions which may arise as to the quality and acceptability of materials furnished, Work performed, rate of progress of Work, interpretation of Drawings and Specifications, and all questions as to the acceptable fulfillment of the Contract on the part of the Contractor.

The Engineer will not be responsible for the construction means, controls, techniques, sequences, procedures, or construction safety.

**B.06.09    Engineer's Decisions**

All claims of the Contractor shall be presented to the Engineer for recommendations to Owner which shall be made in writing within a reasonable time. All recommendations of the Engineer shall be provided to Contractor at the same time as they are provided to Owner.

**B.06.10    Suspension of Work by the Engineer**

Subject to Owner's approval, the Engineer shall have the authority to suspend the Work, wholly or in part, for such period or periods as he may deem necessary, due to unsuitable weather, or such other conditions as are considered unfavorable for prosecution of the Work, or failure on the part of the Contractor to carry out the provisions of the Contract or to supply materials meeting the requirements of the Specifications. The Contractor shall not suspend operation without the Engineer's written permission, which requires Owner's approval.

**B.06.11    Rights of Various Interests**

Whenever work being done by the Owner's forces or by other Contractors is contiguous to Work covered by this Contract, the respective rights of the various interests involved shall be established by the Engineer to secure the completion of the various portions of the Work in general harmony.

## B.07 CONTRACT EXECUTION

### B.07.01 Assignment of Contract

Neither the Contractor nor the Owner shall sublet, sell, transfer, assign, or otherwise dispose of the Contract or any portion thereof, or of his right title or interest therein, or his obligations thereunder, without written consent of the other party.

### B.07.02 LEFT INTENTIONALLY BLANK

### B.07.03 Notice to Proceed

Following execution of the Agreement by the Owner, a written Notice to Proceed with the Work shall be given to the Contractor. The Contractor shall begin and shall prosecute the Work regularly without interruption thereafter (unless otherwise directed in writing by the Owner), with such forces as to secure the completion of the Work within the Contract Time.

### B.07.04 Contractor's Responsibility to Notify Owner and Engineer

After receipt of the Notice to Proceed from the Owner and prior to the start of construction, the Contractor shall notify the Owner and Engineer when the Work is to commence. The Owner will be allowed 3 working days, if needed, to arrange for inspection and testing of the Work.

### B.07.05 Contractor's Responsibility to Notify Governing Agencies

The Contractor shall notify all governing agencies and all concerned utility companies 3 working days prior to the start of construction. Additional notification shall be given by the Contractor to all the above mentioned parties 3 working days prior to crossing, connecting to, or working in the vicinity of any right-of-way or utility owned or controlled by any of the concerned parties.

### B.07.06 Separate Contracts

The Owner may let other contracts in connection with the Work of the Contractor. The Contractor shall cooperate with other contractors with regard to storage of materials and execution of their Work. It shall be the Contractor's responsibility to inspect all Work by other contractors affecting his Work and to report to the Engineer any irregularities which will not permit him to complete his Work in a satisfactory manner. His failure to notify the Engineer of such irregularities shall indicate the Work of other contractors has been satisfactorily completed to receive his Work. The Contractor will not be responsible for defects of which he could not have known, which develop in the work of others after the Work is completed.

### B.07.07 Subcontracts

At the time specified by the Contract Documents or when requested by the Engineer, the Contractor shall submit in writing to the Owner for approval of the Engineer the names of the Subcontractors proposed for the Work. Subcontractors may not be changed except at the



request or with the approval of the Engineer. The Contractor shall not sublet an aggregate total of more than 50 percent of the Contract Amount without written permission of the Owner.

The Contract Documents shall not be construed as creating any contractual relation between any Subcontractor and the Owner. The Contractor shall bind every Subcontractor by the terms of the Contract Documents. For convenience of reference and to facilitate the letting of contracts and subcontracts, the Specifications are separated into titled divisions and sections. Such separation shall not, however, operate to make the Owner or the Engineer an arbiter to establish limits of work of subcontracts between Contractor and Subcontractors.

#### B.07.08 Oral Agreement

No oral order, objection, claim, or notice by any party to the others shall affect or modify any of the terms or obligations contained in any of the Contract Documents, and none of the provisions of the Contract Documents shall be held to be waived or modified by reason of any act whatsoever, other than by a definitely agreed waiver or modification thereof in writing, and no evidence shall be introduced in any proceeding of any other waiver or modification.

#### B.07.09 Changes in the Work

The Owner may, as the need arises, order changes in the Work through additions, deletions, or modifications without invalidating the Contract. The Owner reserves the right to delete or add work costing up to 30 percent of the original total Contract Price without penalty or changes in the Unit Prices shown in the Proposal. Payment and time of completion affected by such changes shall be adjusted at the time of ordering such changes.

#### B.07.11 Extra Work

New and unforeseen items of Work found to be necessary, and which cannot be covered by any item or combination of items for which there is a Contract Price, shall be classed as Extra Work. The Contractor shall do such Extra Work and furnish such materials as may be required for the proper completion or construction of the whole Work contemplated, upon written notice from the Owner as approved by the Engineer. In the absence of such written notice, no claim for Extra Work shall be considered. Extra Work shall be performed in accordance with these Specifications; or special provisions shall be done in accordance with the best practice as approved by the Engineer. Extra Work required in an emergency to protect life and property shall be performed by the Contractor as required.

#### B.07.12 Time for Completion and Liquidated Damages

It is hereby understood and mutually agreed by and between the Contractor and Owner that the date of beginning and the time for completion as specified in the Proposal are ESSENTIAL CONDITIONS of this Contract; and it is further mutually understood and agreed that the Work embraced in this Contract shall be commenced on a date to be specified in the "Notice to Proceed." The Contractor agrees that said Work shall be prosecuted regularly, diligently, and uninterruptedly at such rate of progress as will insure full completion, in an acceptable manner thereof, within the time specified. The Contractor affirms that the time for completion of the Work described herein is a reasonable time for completion of the Work and that he has sufficient plant, equipment, and manpower to accomplish the Work within the specified time for completion. It is further agreed that TIME IS OF THE ESSENCE of each and every portion of

this Contract and of the Specification wherein a definite and certain length of time is fixed for the performance of any act whatsoever; and where under the Contract an additional time is allowed for the completion of any Work, the new time limit fixed by such extension shall become the essence of this Contract.

If the Contractor shall neglect, fail, or refuse to complete the Work within the completion date specified or within any proper extension thereof granted by the Owner, then the Contractor does hereby agree to pay the Owner for such breach of Contract the amount specified in the Proposal for liquidated damages.

#### B.07.13 Extension of the Contract Time

A delay beyond the Contractor's control occasioned by an Act of God, or act or omission on the part of the Owner, or by strikes, lockouts, fire, or other disaster, may entitle the Contractor to an extension of time to be agreed to by Owner, by which to complete the Work, provided, however, that the Contractor shall within five days after the beginning of such delay, give written notice to the Owner of the cause of such delay.

### B.08 USE OF LANDS AND PROPERTY

#### B.08.01 Permits and Licenses

The Contractor shall procure and pay for all permits, licenses, and fees necessary for the execution of the Work unless otherwise specifically provided in the Supplemental Specifications.

#### B.08.02 Lands by Owner

The Owner shall provide the lands upon which the Work under the Contract is to be performed and/or which is to be used for rights-of-way or access all as shown on the Drawings. Any delay in furnishing these lands by the Owner shall be deemed proper cause for adjustment in the time of completion.

#### B.08.03 Lands by Contractor

Any additional land and access thereto not shown on the Drawings that may be required for temporary construction procedures or facilities or for storage of materials shall be provided by the Contractor with no liability to the Owner. The Contractor shall confine his apparatus and storage of materials and operation of his workmen to those areas described in the Drawings and Specifications and such additional areas which he may provide as approved by the Engineer.

#### B.08.04 Private Property

The Contractor shall not enter upon private property for any purpose without obtaining written permission. Copies of such written permission shall be furnished to the Owner or the Engineer upon request. He shall be responsible for the preservation of all public property, trees, monuments, fences, etc. along and adjacent to the street and/or right-of-way, and shall use every precaution necessary to prevent damage or injury thereto. He shall use suitable precautions to prevent damage to pipes, conduits, and other underground structures, and shall protect carefully from disturbance or damage all monuments and property marks until an authorized agent has witnessed or otherwise referenced their location and shall not remove them until directed.

#### B.08.05 Patents and Royalties

If any design, device, material, or process covered by letters, patent, or copyright is used by the Contractor, he shall provide for such use by legal agreement with the owner of the patent or copyright, or by a licensee of such owner, and shall indemnify and save harmless the Owner of the Project from any and all loss or expense on account thereof, including its use by the Owner of the Project.

#### B.08.06 Laws to be Observed

The Contractor shall give all notices and comply with all federal, state, and local laws, ordinances, and regulations in any manner affecting the conduct of the Work, and all such orders and decrees as exist or may be enacted by bodies or tribunals having any jurisdiction or authority over the Work, and shall indemnify and save harmless the Owner against any claim or liability arising from, or based on, the violation of any such law, ordinance, regulation, order, or decree, whether by himself, his employees, or Subcontractors.

### B.09 SURVEYS AND PROJECT CONTROL POINTS

#### B.09.01 Construction Surveys and Survey Control Points

Unless otherwise specified, the Owner, through the Engineer, shall furnish all surveys, lines, and grades reasonably necessary for the control of the Work, but this shall not relieve the Contractor of responsibility for making careful and accurate measurements and for constructing all Work accurately to the lines and grades as shown on the Drawings. The Contractor shall have the responsibility to carefully preserve and protect U.S. government corners, property corners, bench marks, monuments, and reference points (hereinafter referred to as "Survey Control Points") and construction stakes. In case of loss or disturbance of said points during the construction period, the Contractor shall pay the cost of replacement and shall be responsible for any mistakes that may be caused by such loss or disturbance.

#### B.09.02 Protection of Survey Control Points

Prior to beginning of construction, a guard post assembly consisting of 3 posts protruding about 3 feet above the ground shall be constructed around each survey control point. The installation of the guard post assemblies will not be the Contractor's responsibility unless they are listed as a Bid item in the Proposal. However, the guard post assemblies shall be maintained by the Contractor until all of his construction and clean-up Work is completed, except for paving contractors who shall maintain them until the Engineer sets witness stakes and removes the survey control point. The cost of maintaining and replacing disturbed guard post assemblies shall be paid by the Contractor.

### B.10 WORKMANSHIP AND MATERIALS

#### B.10.01 Quality of Equipment and Materials

In order to establish standards of quality, the Engineer has, in the Specifications, referred to certain products by name and catalog number. This procedure is not to be construed as eliminating from competition other products of equal or better quality by other manufacturers where fully suitable in design. However, if the Contractor does desire to make substitutions, he shall observe the following:

- a. The Contractor shall furnish the complete list of proposed desired substitutions prior to signing of the Contract, together with such engineering, catalog, and performance history data as the Engineer may require.
- b. The Contractor shall abide by the Engineer's judgment when proposed substitute materials or items of equipment are judged to be unacceptable and shall furnish the specified material or item of equipment in such case. All proposals for substitutions shall be submitted in writing by the General Contractor and not by Subcontractors or Suppliers. Subject to the Owner's review, the Engineer will approve or disapprove proposed substitutions in writing within a reasonable time. No substitute materials shall be used unless approved in writing.

#### B.10.02 Character of Workmen

The Contractor shall at all times be responsible for the conduct and discipline of his employees and/or any Subcontractor or persons employed by Subcontractors. All workmen must have sufficient knowledge, skill, and experience to perform properly the Work assigned to them. Any foreman or workman employed by the Contractor or Subcontractor who, in the opinion of the Engineer, does not perform his Work in a skillful manner, or appears to be incompetent or to act in a disorderly or intemperate manner shall, at the written request of the Engineer, be immediately removed from the job site and shall not be employed again in any portion of the Work without the approval of the Engineer.

#### B.10.03 Materials Furnished By the Contractor

All materials used in the Work shall meet the requirements of the respective Specifications and shall be new materials and no material shall be used until it has been approved by the Engineer. All materials not otherwise specifically indicated shall be furnished by the Contractor.

The Contractor shall be free to secure the approved material and equipment from sources of his own selection. However, if the Engineer finds that the Work will be delayed or adversely affected in any way because a selected source of supply cannot furnish a uniform product in sufficient quantity or the product is not suitable for the Work, the Engineer shall have the right to require that the original source of supply be changed by the Contractor. The Contractor shall have no claim for damage for additional compensation because of this requirement.

All water used in connection with the Work shall be municipal water. The Contractor shall secure the required permission from the Owner's Water Department and shall bear all the expense of such permission and for the water used. If connections are made by hydrant, the Contractor shall also obtain permission for such connections from the local fire department. Fire department standard hydrant wrench shall be used for opening and closing the hydrant.

#### B.10.04 Materials Furnished by the Owner *(not applicable to earthwork)*

When the Contract Documents indicate that materials are to be furnished by the Owner, the furnishing of such material is conclusive evidence of its acceptability for the purpose intended, and the Contractor may continue to use it until otherwise directed. If the Contractor discovers any defect in material furnished by the Owner, he shall notify the Engineer. Unless otherwise noted or specifically stated, materials furnished by the Owner which are not of local occurrence are considered to be FOB the nearest railroad station. The Contractor shall be prepared to

unload, transport, and properly protect all such material from damage or loss. The Contractor shall be responsible for material loss or damage after receipt of material at the point of delivery.

## B.11 PUBLIC SAFETY

### B.11.01 Compliance with Applicable Safety Standards and Regulations

The Contractor will be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the Work. He shall take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to: all employees on the Work and to other persons who may be affected thereby; all the Work and all materials or equipment to be incorporated therein, whether in storage on or off the site; and other property at the site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, and those structures and utilities not designated for removal, relocation, or replacement in the course of construction.

The Contractor shall comply with all applicable laws, ordinances, rules, regulations, and orders of any public body having jurisdiction. He shall erect and maintain, as required by the conditions and progress of the Work, all necessary safeguards for safety and protection. He shall notify Owners of adjacent utilities when prosecution of the Work may affect said utilities.

The Contractor shall remedy all damage, injury, or loss to any property caused, directly or indirectly, in whole or in part, by his operations, or by any Subcontractor or anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them be liable.

### B.11.02 Warning Signs and Barricades

The Contractor shall provide adequate signs, fences, barricades, signal lights, and watchmen and shall take all necessary precautions for the protection of the Work and the safety of the public. All barricades and obstructions shall be protected at night by signal lights which shall be kept lighted from sunset to sunrise. Suitable warning signs shall be so placed and illuminated at night to show in advance where construction, barricades, or detours exist. Such warning and protection devices shall comply with the requirements of the governing agency.

### B.11.03 Public Safety and Convenience

The Contractor shall at all times so conduct his Work as to insure the least possible obstruction to traffic and inconvenience to the general public and the residents in the vicinity of the Work, and to insure the protection of persons and property in a manner satisfactory to the Engineer and proper governmental authority. All local, state, and national laws, ordinances, rules, and regulations pertaining to the kind, use, and loading of all apparatus, equipment, and material shall be complied with as well as all other reasonable precautions required by the Engineer to insure safe working conditions. Mailboxes, fire hydrants, water supply valves, and gas valves on or adjacent to the Work shall be accessible at all times.

Temporary provisions shall be made by the Contractor to insure the use of mailboxes, sidewalks and the proper functioning of all sewers, sewer inlets, gutters, and drainage ditches.

The Contractor has the sole responsibility for the proper construction of the Project and is solely responsible for: the safety in, on, or about the job site; control of the safety or adequacy of any equipment, building component, scaffolding, sheeting, bracing, forms, or other Work aids; and superintending the Work. Construction review, or inspection by the Owner or the Engineer, shall not relieve the Contractor of the above responsibilities.

#### B.11.04 Work During an Emergency

The Contractor shall perform any Work and shall furnish and install any materials and equipment necessary during an emergency endangering life or property. In all cases he shall notify the Engineer of the emergency as soon as practicable, but he shall not wait for instructions before proceeding to properly protect both life and property.

### B.12 MEASUREMENT AND PAYMENT

#### B.12.01 Breakdown of Contract Amount

In cases where a Lump Sum Contract Amount forms the basis for payment under the Contract, the Contractor shall, within 10 days of receipt of the Notice to Proceed, submit a complete breakdown of the Contract Amount. The breakdown shall show the value assigned to each part of the Work, including an allowance for profit and overhead. Upon approval of the breakdown by the Engineer, it shall be used as a basis for all requests for payment. The approved breakdown will not be considered as fixing a basis for additions to or deductions from the Contract Amount.

In cases where Unit Prices form the basis for payment under the Contract, the summation of amounts determined by multiplying the total number of each of the completed units of Work by the Unit Price stated in the Proposal for that item shall be used as the basis for payment requests. The number of units contained in the Proposal is approximate only, and final payment will be made for the actual number of units that are incorporated into or made necessary by the Work covered in the Contract.

#### B.12.02 Requests for Payment

Periodically (at the specified times, but not more than once a month), the Contractor shall submit to the Owner, through the Engineer, a Request for Payment for Work performed. A copy of the Contractor's Declaration (in the form attached at the rear of this division) shall be completed, signed, and attached to each Request for Payment. Waivers of lien shall be required from subcontractors and suppliers when they have provided labor and/or materials on the Project. Also to be included are any other periodic reports required (such as monthly payrolls, etc.).

In cases where a Lump Sum forms the basis for payment under the Contract, the Request for Payment shall indicate the Work completed to date on the items listed in the approved "Breakdown of the Contract Amount". If the Request for Payment includes materials and equipment stored on the site, it shall be accompanied by invoices from the manufacturer or Supplier or such other information satisfactory to the Owner.

In cases where Unit Prices form the basis for payment under the Contract, the Request for Payment shall state the units of Work completed to date. If the Request for Payment includes materials and equipment stored on the site, it shall be accompanied by invoices from the manufacturer or Supplier or such other information satisfactory to the Owner. In cases where Lump Sum items are included in a Unit Price Contract, the Contractor shall be paid for the percentage of Work completed, as determined by the Engineer.

#### B.12.03 Engineer's Certificate for Payment

Each Request for Payment shall be submitted to the Engineer. Within 10 days after receipt of the Contractor's Request for Payment, the Engineer shall verify the Request for Payment and prepare and submit to the Owner an Engineer's Certificate for Payment based upon an approved Request for Payment or upon the Engineer's estimate of the Work completed from the start of the Work up to the date of the Request for Payment. The Engineer's Certificate for Payment shall not certify for payment, Work that has not been completed in compliance with the Contract Documents.

#### B.12.04 Progress Payments to the Contractor

Not later than the date specified in the Supplemental General Provisions, the Owner shall make a Progress Payment to the Contractor on the basis of the Engineer's Certificate for Payment, less amounts for Work Owner claims and specifies as not completed in compliance with the Contract Documents; but to insure proper performance of the Contract, the Owner may retain 10 percent of the amount of the Engineer's Certificate for Payment until completion and acceptance of all Work covered by the Contract. However, the maximum amount so retained shall not exceed 5 percent of the bid contract amount.

#### B.12.05 Owner's Right to Withhold Progress Payments

In addition to Owner's rights under Section B.12.04, the Owner may withhold any Progress Payment, in whole or in part, on an Engineer's Certificate for Payment to the extent necessary to protect himself from loss on account of any of the following causes discovered subsequent to the submittal of the Engineer's Certificate:

- a. Defective Work.
- b. Evidence indicating probable filing of claims by other parties against the Contractor.
- c. Failure of the Contractor to make payment to Subcontractors and/or material Suppliers.
- d. Damage to another Contractor's work.
- e. Failure to submit periodic reports required by the Contract Documents.

#### B.12.06 Payment for Rejected Work and Materials

The removal of rejected Work and materials and the re-execution of such Work in an acceptable state shall be done by or at the expense of the Contractor; and he shall pay the cost of replacing other contractors' work which is destroyed or damaged by the removal and subsequent replacement of the rejected Work or materials.

The cost of removing rejected Work or materials by the Owner shall be paid by the Contractor or deducted from payments due the Contractor for Work done under this Contract.



B.12.07 Payment for Uncorrected Work

Should the Owner approve the Contractor not correcting Work that has been damaged or that has not been performed in accordance with the Contract Documents, an equitable deduction from the Contract Price shall be made to compensate the Owner for the uncorrected Work.

B.12.08 Payment for Work by the Owner

The cost of the Work performed by the Owner in removing construction equipment, tools, and supplies and for correcting deficiencies shall be paid by the Contractor.

B.12.09 Payment for Work Suspended by the Owner

If the Work or any part thereof shall be suspended by the Owner for more than 30 days without Contractor's approval, the Contractor will then be entitled to payment for all Work done to the date of suspension.

B.12.10 Payment for Work Done by the Owner Following His Termination of the Contract

Upon termination of the Contract by the Owner, no further payments shall be due the Contractor until the Work is completed. If the unpaid balance of the Contract Amount shall exceed the cost of completing the Work (including all overhead cost), the excess shall be paid to the Contractor. If the cost of completing the Work shall exceed the unpaid balance, the Contractor shall pay the difference to the Owner within 30 days of Owner's written notice of the amount owed. The cost incurred by the Owner, as herein provided, and the damage incurred through the Contractor's default, shall be certified by the Owner and approved by the Engineer.

B.12.11 Payment for Work Terminated by the Contractor

Upon suspension of the Work or termination of the Contract by the Contractor in accordance with Section B.06.03, the Contractor shall be entitled to payment from the Owner for the Work performed.

B.12.12 Payment for Replacing Survey Control Points and Construction Stakes

Notwithstanding any liability which may be imposed by law on the Contractor for loss or disturbance of survey points, the Contractor shall pay the cost of replacing survey points lost or disturbed as a result of Work under the Contract. In addition to the replacement cost, the Contractor shall be liable for any other expenses, damages, or mistakes caused by such loss or disturbance. The cost of replacing U.S. government corners, property corners, bench marks, monuments, and reference points (known collectively as survey control points) shall be the actual cost as certified by the Engineer.

The cost of replacing or relocating construction stakes shall not be based solely on the number of such stakes replaced but shall be based upon the number of occurrences in which the Engineer is required to replace or relocate lost or disturbed stakes. For each such occurrence, the cost shall be the actual cost to the Owner. The Engineer shall certify to the Owner in the final Engineer's Certificate for Payment the actual cost for replacing all survey control points and/or construction stakes.



The total actual cost as certified by the Engineer shall be deducted from the earned amount due the Contractor for Work under the Contract.

#### B.12.13 Payment for Extra Work

Written notice of claims for payments for Extra Work shall be given by the Contractor within 10 days after receipt of the request for extra work from the Owner. No claim for Payment for extra work shall be valid unless so made. In all cases, the Contractor's itemized estimate sheets showing all labor and material shall be submitted to the Engineer. The Owner's order for Extra Work shall be in the form of a Change Order to be signed by both Owner and Contractor and shall specify any extension of the Contract time and one of the following methods of payment:

- a. Unit Prices or combinations of Unit Prices which formed the basis of the original Contract.
- b. A Lump Sum based on the Contractor's estimate, approved by the Engineer and accepted by the Owner.
- c. Actual cost of direct Work by the Contractor plus 15 percent for overhead and profit. Actual cost of Subcontract Work shall include 5 percent for the Contractor's overhead and profit. Actual cost of direct Work by the Contractor shall be:
  1. Labor Costs shall be the amount shown on the Contractor's payroll plus unemployment taxes and Workmen's Compensation Insurance when such additional taxes or insurance costs can be shown to have been incurred.
  2. Material Costs shall be the net price paid for material delivered to the site of the Work.
  3. Equipment Rental shall be the actual additional costs incurred for necessary equipment actually used in the Extra Work. No payment will be made for equipment not used in the Extra Work. All costs shall be computed using the basic monthly rental rate as published in the current edition of "Rental Rates for Construction Equipment Bluebook" published by the Equipment Guide-Book Company. For periods of less than a month the daily rate shall be computed as 1/22 of the monthly rate with no allowance for fuel or other operating costs.

#### B.13 COMPLETION AND ACCEPTANCE OF THE WORK

##### B.13.01 Guarantees

The Contractor shall warrant all equipment furnished and Work performed by him for a period of two (2) years from the date of final payment for the Contract Work regardless of the terms of any manufacturer or supplier warranties.

##### B.13.02 Use of Completed Portions of the Work

The Owner shall have the right to take possession of and use any completed or partially completed portions of the Work, notwithstanding that the time for completing the entire Work or such portions may not have expired; but such taking possession and use shall not be deemed an acceptance of any Work not completed in accordance with the Contract Documents.

#### B.13.03 Release of Liens

To the extent not required in connection with a progress payment request, the Contractor shall deliver to the Owner a complete release of all liens or claims arising out of this Contract before the retained percentage or the final Request for Payment is paid. If any lien or claim remains unsatisfied after all payments are made, the Contractor shall refund to the Owner such amounts as the Owner may have been compelled to pay in discharging such liens, or claims, including all costs and a reasonable attorney's fee.

#### B.13.04 Acceptance and Final Payment

When the Contractor shall have completed all the Work in accordance with the terms of the Contract Documents, the Contractor shall submit to the Owner, through the Engineer, the following items for review:

- a. A signed Contractor's Declaration
- b. A signed Contractor's Affidavit on a form furnished by the Owner.
- c. Release of Liens and Claims described above.
- d. Waiver of Liens and Claims from all Suppliers and Subcontractors indicating that all debts for labor, materials, and equipment incurred in connection with this Contract have been paid in full.
- e. Certificate of Completed Operations Insurance for 1 year after final payment.

Letters of Release may be required approving final payment to the Contractor from all agencies concerned with the Work, including the state highway department, county road commissions, the Office of Public Works, municipalities, electric, gas, telephone and other utilities, railroad companies, and the Contractor's surety company. The Contractor shall allow sufficient time after submittal of the above data for verification.

The Engineer shall certify his approval of the Final Contract Amount which shall be the original Contract Amount plus all approved additions less all approved deductions and the Engineer shall forward all submitted data to the Owner.

Thereafter, the Owner will review all data submitted for compliance with the Contract requirements and, when approved, will accept the Work subject to Contractor's Bonds, any legal rights of the Owner, required guarantees, and Contractor's responsibility for correction of faulty work after final payment, and make final payment to the Contractor.

#### B.13.05 Correction of Faulty Work After Final Acceptance

The approval by the Engineer of the final Request for Payment, and the making of the final payment by the Owner to the Contractor, shall not relieve the Contractor of responsibility for faulty materials or workmanship. The Owner shall promptly give the Contractor notice of any faulty materials or workmanship discovered within 2 years after the date of final payment for the Contract Work; and the Contractor shall promptly replace any such defects.

CONTRACTOR'S DECLARATION

(to be attached to the Contractor's periodic request for payment)

Project Description \_\_\_\_\_

Contract No. \_\_\_\_\_

Contract Date \_\_\_\_\_

Job No. \_\_\_\_\_

Contractor \_\_\_\_\_

Owner \_\_\_\_\_

Certification Period: \_\_\_\_\_

From the Date of the Contract to the Date of this Declaration.

I hereby certify that I have not, during the above noted certification period, performed any work, furnished any material, sustained any loss, damage or delay for any reason, including soil conditions encountered or created, or otherwise done anything for which I shall ask, demand, sue for, or claim compensation from the Owner or his agents, in addition to the regular items set forth in the above noted Contract (and executed Change Orders thereto) executed between myself and the Owner, except as I hereby claim for additional compensation and/or extension of time as described in previously submitted claim letters to the Owner dated:

|       |       |
|-------|-------|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

Contractor \_\_\_\_\_

By \_\_\_\_\_  
(Authorized Signature)

Title \_\_\_\_\_

Date \_\_\_\_\_

## CONTRACTOR'S AFFIDAVIT

The undersigned Contractor, \_\_\_\_\_  
hereby represents that on \_\_\_\_\_ (it) was awarded a Contract  
by, \_\_\_\_\_  
\_\_\_\_\_ hereinafter called the Owner, to  
construct \_\_\_\_\_ in accordance with the terms and  
conditions of Contract No. \_\_\_\_\_; and the undersigned further represents that  
the subject Work has now been accomplished and the said Contract has now been completed.

The undersigned hereby warrants and certifies that all of (its) indebtedness arising by reason of  
the said Contract has been fully paid or satisfactorily secured; and that all claims from  
Subcontractors and others for labor and material used in accomplishing the said Project, as well  
as all other claims arising from the performance of the said Contract, have been fully paid or  
satisfactorily settled. The undersigned further agrees that, if any such claim should hereafter  
arise, (it) shall assume responsibility for the same immediately upon request to do so by the  
Owner.

The undersigned, for the total Contract consideration of \_\_\_\_\_  
the receipt of which is hereby acknowledged, does further hereby waive, release, and relinquish  
any and all claims or right of lien which the undersigned now has or may hereafter acquire upon  
the subject premises for labor and material used in accomplishing said Project, or upon the  
Owner, the Consulting Engineers, and their respective employees or agents.

This affidavit is freely and voluntarily given with the full knowledge of the facts, on this \_\_\_\_\_  
day of \_\_\_\_\_, 20 \_\_\_\_\_.

Contractor \_\_\_\_\_

By \_\_\_\_\_

Title \_\_\_\_\_

Subscribed and sworn to before me, a Notary Public  
in and for \_\_\_\_\_ County, Michigan  
on this \_\_\_\_\_ day of \_\_\_\_\_, 20 \_\_\_\_.

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

My Commission Expires: \_\_\_\_\_

## PARTIAL WAIVER OF LIEN

To All Whom It May Concern:

Whereas, the undersigned has been employed by (A) \_\_\_\_\_  
\_\_\_\_\_  
to furnish labor and materials for (B) \_\_\_\_\_  
\_\_\_\_\_ work,  
under a contract (C) \_\_\_\_\_  
for the improvement of the premises described as (D) \_\_\_\_\_  
\_\_\_\_\_  
in the \_\_\_\_\_ (City-Village) of \_\_\_\_\_, County of  
\_\_\_\_\_, State of \_\_\_\_\_  
of which \_\_\_\_\_  
\_\_\_\_\_ is the Owner.

NOW, THEREFORE, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, for  
and in consideration of the sum of (E) \_\_\_\_\_ Dollars  
paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the  
undersigned does hereby waive and release to the extent only of the aforesaid amount, any lien rights to,  
or claim of lien with respect to and on said above-described premises, and the improvements thereon, and  
on the monies or other considerations due or to become due from the Owner, by virtue of said contract, on  
account of labor, services, materials, fixtures, apparatus or machinery furnished by the undersigned to or  
for the above-described premises, but only to the extent of the payment aforesaid.

(F) \_\_\_\_\_ (SEAL)  
(Name of the sole ownership, corporation or partnership)  
(Affix corporate seal here)

\_\_\_\_\_  
(Signature) \_\_\_\_\_ (SEAL)  
TITLE: \_\_\_\_\_

### INSTRUCTIONS FOR PARTIAL WAIVER

- (A) Name person or firm with whom you agreed to furnish either labor, or services, or materials, or both.
- (B) Fill in nature and extent of work; strike the word labor or the word materials if not in your contract.
- (C) If you have more than one contract on the same premises, describe the contract by number if available, date and extent of work.
- (D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.
- (E) Amount shown should be the amount actually received on that date.
- (F) If waiver is for the corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

## FINAL WAIVER OF LIEN

To All Whom It May Concern:

Whereas, the undersigned has been employed by (A) \_\_\_\_\_  
\_\_\_\_\_  
to furnish labor and materials for (B) \_\_\_\_\_  
\_\_\_\_\_ work,  
under a contract (C) \_\_\_\_\_  
for the improvement of the premises described as (D) \_\_\_\_\_  
\_\_\_\_\_  
in the \_\_\_\_\_ (City-Village) of \_\_\_\_\_, County of  
\_\_\_\_\_, State of \_\_\_\_\_  
of which \_\_\_\_\_  
\_\_\_\_\_ is the Owner.

NOW, THEREFORE, this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, for  
and in consideration of the sum of (E) \_\_\_\_\_ Dollars  
paid simultaneously herewith, the receipt whereof is hereby acknowledged by the undersigned, the  
undersigned does hereby waive and release any lien rights to, or claim of lien with respect to and on said  
above-described premises, and the improvements thereon, and on the monies or other considerations due  
or to become due from the Owner, on account of labor, services, materials, fixtures, apparatus or machinery  
heretofore or which may hereafter be furnished by the undersigned to or for the above-described premises  
by virtue of said contract.

(F) \_\_\_\_\_ (SEAL)  
(Name of the sole ownership, corporation or partnership)  
(Affix corporate seal here)

\_\_\_\_\_  
(Signature) \_\_\_\_\_ (SEAL)  
TITLE: \_\_\_\_\_

### INSTRUCTIONS FOR PARTIAL WAIVER

- (A) Name person or firm with whom you agreed to furnish either labor, or services, or materials, or both.
- (B) Fill in nature and extent of work; strike the word labor or the word materials if not in your contract.
- (C) If you have more than one contract on the same premises, describe the contract by number if available, date and extent of work.
- (D) Furnish an accurate enough description of the improvement and location of the premises so that it can be distinguished from any other property.
- (E) Amount shown should be the amount actually received on that date.
- (F) If waiver is for the corporation, corporate name should be used, corporate seal affixed and title of officer signing waiver should be set forth; if waiver is for a partnership, the partnership name should be used, partner should sign and designate himself as partner.

## DIVISION B1

### SUPPLEMENTAL GENERAL PROVISIONS

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

The language noted below shall replace and/or take precedence over paragraph B.12.04 in Division-B (General Provisions) of the Contract Documents:

To accommodate the meeting schedule of the Charter Township of Independence (Owner) Board of Trustees at which Progress Payments are to be approved, Owner and \_\_\_\_\_ as Contractor hereby agree that General Condition B.12.04, Owner's payments are to be made not later than the 30<sup>th</sup> day after receipt of the Engineer's Certificate for Payment unless there is no regular meeting of the Township Board of Trustees within that time in which case the payment shall be made within two (2) days of that meeting.

But to insure proper performance of the Contract, the owner may retain 10 percent of the amount of the Engineer's Certificate for Payment until completion and acceptance of all Work covered by the Contract. However, the maximum amount so retained shall not exceed 5 percent of the bid Contract amount.

Contractor \_\_\_\_\_

By \_\_\_\_\_  
Name Title

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## DIVISION 1 - GENERAL REQUIREMENTS

### 01.01 SUMMARY OF THE WORK

#### 01.01.01 Work Covered By Contract Documents

The following Specifications for Contract Work, including "Division 1-General Requirements" and the supplementary specifications, as included, set forth conditions or requirements peculiar to the Work to be performed under this Contract. The Work to be performed shall be as described in the plans and Supplemental Specifications. The method of measurement and basis of payment for Work performed shall be as indicated in the Proposal and described in the following specifications. Under each item of Work listed in the Proposal and herein described, the Contractor shall furnish: all labor and materials; tools, plant, equipment, supplies, and bonds; costs of heating, lighting, and power; tests of construction materials as required under any section of these Specifications; and all Work that may be specifically described and included in the following specifications (under the respective items, whether incidental or otherwise) necessary to complete the Work in accordance with the obvious or expressed intent of the Contract. The supplementary specifications are prepared utilizing/referencing the Michigan Department of Transportation's 2012 Standard Specifications for Construction, and said specifications are incorporated into the contract documents for the various pay items of work referenced in the bid proposal.

#### 01.01.02 Contractor's Use of Premises

The Contractor shall confine his operations at the site to areas permitted by Law, Ordinances, Permits, and the Contract Documents.

The Contractor shall not load or permit any part of any existing or proposed structure to be subjected to any forces that will endanger its safety.

The Contractor shall not discharge any smoke, dust, or other contaminants into the atmosphere, or discharge any fluids or materials into any waterway as will violate regulations of any legally constituted authority.

The Contractor shall assume full responsibility for protection and safekeeping of any products stored on the premises. The Contractor shall move any stored products which interfere with the operations of the Owner or other Contractors. The Contractor shall obtain and pay for any additional storage or work areas needed for his operations.

#### 01.01.03 Existing Facilities Operations

The existing facilities are to be operated as described in the Supplemental Specifications. The Contractor shall plan and conduct the construction operations to avoid disturbing the existing facilities, piping, equipment and services in any manner that will interrupt or impair operations, except as approved by the Engineer.

The Contractor shall submit for approval a construction sequence, detailed Drawings, and written explanations of all temporary facilities and appurtenances intended to be used in maintaining the uninterrupted operations of the existing facilities, if described in the Supplemental Specifications.

#### 01.01.04 Hours of Work

The Contractor is required to prosecute Work done under this Contract during the hours of daylight, and no Work will be permitted at night, on Sundays, or on holidays unless specifically authorized by the Engineer and by written approval of the local unit of government. Should the Contractor elect to work at night, Sundays, or on holidays, a copy of the written approval of the local unit of government and regulatory agencies shall be submitted to the Owner and to the Engineer prior to commencing said Work.

#### 01.01.05 Cutting and Patching

The Contractor shall do all cutting, fitting, or patching of his Work that may be required to make its several parts come together properly and fit it to receive or be received by Work of other Contractors shown upon, or reasonably implied by, the Drawings and Specifications for the completed Work as the Engineer may direct.

#### 01.01.06 Subsurface Exploration

The Contractor shall assume all risk and responsibility because of existing soil conditions. The Contractor shall make his own determination as to soil conditions and he shall complete the Work in whatever manner and under whatever conditions he may encounter or create. This shall apply whether or not borings are included in the Contract Documents. Any soil information shown in the Contract Documents, or attached in the Appendix, is given solely for the Contractor's information and is to be used at his own discretion.

It shall be the Contractor's responsibility to evaluate data provided, along with making any onsite inspections which he may consider necessary, to protect his interests in the Project. It will also be the responsibility of the Contractor to report to the Engineer as soon as possible any subsurface conditions found to be contradictory to those outlined in the above mentioned report.

It is also noted that there will be no compensations made to the Contractor for soil explorations and/or analysis thereof. All Work, either incidental or directly related to the Contract, shall be performed at the Contract Prices regardless of soil conditions encountered.

### 01.02 PROJECT MEETING(S)

#### 01.02.01 Preconstruction Meeting

After receipt of the "Notice to Proceed," the Contractor shall have the audiovisual tape coverage of construction area performed (if listed in the Proposal as a bid-item) and shall submit to the owner a construction progress schedule showing in a clear graphical manner, satisfactory to the Owner, the proposed dates for commencement, progress, and completion for the Work. The audiovisual tapes and construction schedule shall be submitted to the Owner for review 1 week prior to the scheduled preconstruction meeting. After the Contractor's schedule has been approved and the audiovisual tapes have been reviewed and found acceptable, the Owner shall schedule a preconstruction meeting. The Contractor shall attend the preconstruction meeting at the time and place arranged by the Owner, at which various utility companies, the Engineer, the designated inspection agencies, local municipal officials, governmental agency representatives and the Owner's Representatives will be present to discuss the Project.

#### 01.02.02 Progress Meetings

Periodic progress meetings shall be conducted, as determined necessary by the owner, during the life of the Contract. The Contractor shall attend these progress meetings and their Subcontractor shall also attend these meetings when requested. The purpose of these meetings shall be to update the construction schedule, discuss and resolve construction related problems, and obtain and exchange Project related information from the owner and the Engineer.

#### 01.03 SUBMITTALS

##### 01.03.01 Materials Certification

Where called for in the Specifications or requested by the Engineer, the Contractor shall secure and submit to the Engineer two copies of materials certificates.

##### 01.03.02 Shop Drawings

The Contractor shall submit to the Engineer an electronic copy of any Shop Drawings, required by the Specification sections. The Contractor shall review Shop Drawings, product data, and samples for general compliance with the Contract Documents prior to submission to the Engineer. The Contractor shall verify field measurements, field construction criteria, catalog numbers, and similar data.

The Contractor shall coordinate each submittal with the requirements of the Contract Documents and shall submit Shop Drawings for major equipment items in one package to permit checking complete installation details in all involved trades. The Engineer's review of a separate item does not constitute approval of an assembly in which the item functions.

After the Shop Drawings have been reviewed by the Contractor, in a clear space above the title block or on the back in the upper right-hand corner, hand stamp the following and enter the required information:

Owner's Name: \_\_\_\_\_  
Project Title: \_\_\_\_\_  
Contractor's Name: \_\_\_\_\_  
Date: \_\_\_\_\_  
Identification: \_\_\_\_\_  
Contract Drawing No.: \_\_\_\_\_  
Specification Section \_\_\_\_\_ Paragraph No. \_\_\_\_\_

This document has been checked for accuracy of content and for compliance with the Contract Documents. The information contained herein has been fully coordinated with all involved Subcontractors.

Subcontractor: \_\_\_\_\_  
Signed for Contractor: \_\_\_\_\_  
(Signature)  
(Print Name and Title) \_\_\_\_\_

The Contractor's responsibility for errors, omissions, and deviations from requirements of the Contract Documents in submittals is not relieved by the Engineer's review of Shop Drawings. The Contractor shall notify the Engineer, in writing at time of submission, of any deviations on the Shop Drawings from the requirements of the Contract Documents.

The Contractor shall not install materials or equipment which requires submittals until the submittals are returned with the Engineer's signature.

Shop Drawings that indicate material, equipment, or details that do not conform to the Contract Documents will be rejected and returned to the Contractor with an explanation given why the Shop Drawings are unsatisfactory. The Engineer shall review and return one copy of all submittals to the Contractor within 15 days after the date the submittals have been received. The Contractor shall make the necessary corrections or obtain the necessary information or data and resubmit until the Shop Drawings comply with the Contract Documents.

After the Shop Drawings have been determined to be acceptable, the Contractor shall submit the number of copies he requires for distribution plus five copies which will be retained by the Engineer. All Shop Drawings shall be folded to an approximate size of 8-1/2 by 11 inches in such a manner that the title block will be located in the lower right-hand corner of the exposed surface and provide a one inch margin on the left-hand side for binding purposes.

#### 01.03.03 Samples

All samples called for in the Specifications or required by the Engineer shall be furnished by the Contractor and shall be submitted to the Engineer for his review. Samples shall be furnished so as not to delay fabrication, allowing the Engineer reasonable time for the consideration of the samples submitted. Contractor shall furnish such samples of material as may be required for examination and test. All materials for tests shall be taken according to methods provided in the Specifications. The Contractor shall furnish such assistance and facilities as the Engineer may require for collecting, storing, and forwarding the samples. The entire cost of taking the samples and delivering them to the testing authority shall be paid for by the Contractor at no cost to the Owner. The physical cost of testing by the testing authority shall be paid for by the Owner at no cost to the Contractor.

Failure of samples to meet Contract requirements shall be sufficient cause for refusal to consider any further samples of the same brand from the manufacturer whose equipment has failed.

Any of the materials or equipment delivered on the site or in place may be taken by the Owner or Engineer for testing. Materials or equipment which fail to meet Contract requirements will automatically void previous approvals of the items tested. The Contractor shall replace all such disapproved materials or equipment at his own cost.

Tests will be made by such methods and in such numbers as the Engineer determines to be adequate and equitable. When materials are required to conform to Federal, NCPI, AWWA, or ASTM specifications, and such specifications are accepted as establishing the technical qualities and testing methods, they shall not necessarily govern the number of tests required to be made. The Engineer may require laboratory tests on samples submitted or may approve materials on the basis of data submitted in certificates with the samples.

If the tests of the samples submitted indicate that the proposed material will not conform to the Contract requirements, the Engineer will notify the Contractor that the proposed material is unacceptable and rejected and will furnish the Contractor the basic reasons for such rejection. However, the Engineer will not be required to furnish the Contractor with copies of all the test data and results.

All materials rejected by the Owner or his Representative shall be indelibly marked and immediately removed from the site of the Work.

#### 01.03.04 Operations and Maintenance Data

The Contractor shall furnish three copies of complete catalog data for every manufactured item of equipment and all components to be used in the Work, including specific performance data, material description, rating, capacity, working pressure, material gauge or thickness, brand name, catalog number, and general type.

- a. This submission shall be compiled by the Contractor and reviewed by the Engineer for general compliance with the Contract Documents before any of the equipment is ordered. The Engineer's review does not relieve the Contractor of his responsibility for correctness of dimensions or details.
- b. Each data sheet or catalog in the submission shall be indexed according to Specifications section and paragraph for easy reference.
- c. If the Engineer's review determines the submitted data to be in general compliance with the Contract Documents, the submitted data shall become a part of the Contract, and may not be deviated from except upon written approval of the Engineer.
- d. Catalog data for equipment reviewed by the Engineer does not in any case supersede the Contract Documents. The review of the Engineer shall not relieve the Contractor of responsibility for deviations from Drawings or Specifications, unless he has in writing called the Engineer's attention to such deviations at the time of submission, nor shall it relieve him from responsibility for errors of any sort in the items submitted.

The Contractor shall check the Work described by the catalog data for conformance with the Contract Documents.

- e. It shall be the responsibility of the Contractor to ensure that items to be furnished fit the space available. He shall make necessary field measurements to ascertain space requirements, including those for connections, and shall order such sizes and shapes of equipment that the final installation shall suit the true intent and meaning of the Drawings and Specifications.
- f. Where equipment requiring different arrangement of connections from those shown is approved, it shall be the responsibility of the Contractor to install the equipment to operate properly, and in harmony with the intent of the Drawings and Specifications, and to make all changes in the Work required by the different arrangement of connections.

#### 01.03.05 Record (As-Built) Documents by the Contractor

The Contractor will keep one record copy of all Specifications, Drawings, Addenda, Modifications, and Shop Drawings at the site in good order and annotated to show all changes made during the construction process.

These record documents shall be available to the Engineer and shall be delivered to him for the Owner upon completion of the Project.

#### 01.03.06 Contractor's Progress Schedule

The Contractor shall prepare a detailed construction progress schedule in graphic form showing the proposed dates of starting and completing each major Division of the Work. The schedule shall be consistent with the time, order of Work and requirements of the Specifications, and shall be the basis of the Contractor's proposed operations. Information included on the progress schedule shall include, but not be limited to the following:

- Beginning and completion dates for major items or phases of Work as identified in the Contract Documents
- Contractor's proposed method of construction
- Designation of the Project Superintendent
- Proposed number of crews
- Estimated date of completion
- Contractor's proposed Construction Safety Program to include weekend, emergency, traffic, and maintenance telephone numbers. Personnel listed for contact should be fully qualified to - act on behalf of the Contractor as his agent
- The name, address, telephone number, and specialty of any Subcontractors proposed to conduct Work
- The source and Supplier of materials and equipment to be furnished

The Contractor shall submit 1 reproducible copy of the proposed progress schedule to the Engineer for review 2 weeks prior to the scheduled preconstruction meeting. If requested by the Engineer, the Contractor will revise and resubmit the progress schedule prior to the preconstruction meeting. If during the execution of the Work the Contractor falls behind or advances ahead of the proposed schedule, said schedule, upon request by the Engineer, will be revised by the Contractor based on the current status of the Work.

#### 01.03.07 Construction Photographs

If required by the Supplemental Specifications (Division 30), the Contractor shall furnish photographs in the number, type, and stage as enumerated below.

For each contract, the Contractor shall have 2 photographs made of the Work every 2 weeks as it progresses. The photographs shall be of such views and taken at such times as the Engineer directs.

All photographic work shall be done by a qualified, established commercial photographer acceptable to the Owner. One 8 inch by 10 inch color (or black and white when requested) print as well as the negative of each photograph shall be furnished to the Owner. Prints shall be inserted in transparent sheet protectors provided with punching for a 3-ring binder. Suitable binders shall be provided.

Each photograph shall have a permanent negative title block in the lower right-hand corner, approximately 2-1/4 inches wide by 1-3/4 inches high, stating therein in neat lettering:

1. Owner's Name
2. Project Title
3. Contractor's Name
4. Description of View
5. Photo Number and Date
6. Consulting Engineer's Name
7. Project Number

#### 01.04 QUALITY CONTROL

##### 01.04.01 Grades, Lines, and Levels

###### a. General

All Work under this Contract shall be built in accordance with the lines and grades shown on the Drawings or as altered or modified by the authority of the Owner.

All construction survey work provided by the Contractor shall be performed under the supervision and direction of a Registered Land Surveyor licensed to practice in the State of Michigan. (See Special Provision concerning Contractor Staking).

The Contractor shall have the responsibility to carefully preserve and protect the United States Government corners, established reference points, bench marks, property corners, monuments, and construction stakes. The Contractor shall notify the Engineer whenever any of these points are lost, disturbed, or require relocation. In case of loss or disturbance of these points during the construction period, the Contractor shall pay the cost of replacement and restaking, and shall be responsible for any mistakes that may be caused by such loss or disturbance.

Wherever in the Contract Documents there are given survey stations, bearings, or similar survey designations for the location of structures, or portions of structures, it is understood that they are approximate only, and no change of such designations caused by the developments of construction shall be made the basis of claims for payment other than provided for in the Contract.

###### b. Construction Surveys to be Furnished by Owner Building Construction

The Owner will provide construction control baselines and will provide a Master Bench Mark at the site. The Contractor shall be responsible for the layout and location of all new construction, including the proper elevation of such construction.

###### c. Tunnel Construction

The Owner will provide vertical and horizontal control points. The Contractor shall accurately locate his Work from these reference points and shall be responsible for the installation of all Work to the lines and grades as shown on the Drawings.



The Contractor shall provide the Engineer with reasonable and necessary opportunities to check the accuracy of all Work as to the lines and grades shown on the Drawings. This shall consist of the placement and removal of alignment points, and furnishing such materials and giving such assistance to the Engineer as may be necessary to check the Work. It may be necessary to stop construction during the checking operation. No compensation shall be paid to the Contractor for any Work, materials, labor, or delays as a result of making these checks or other necessary measurements. If it is found necessary to carry on these operations at any time other than normal working hours (namely, over 8 hours a day, Saturday, Sunday, and holidays), the Contractor shall pay the Owner all additional overtime cost of such checking Work.

d. Open Cut Construction

The Owner will provide all surveys, lines, and grades reasonably necessary for the control of the Work. The Contractor shall be responsible for making careful and accurate measurements and for constructing all Work accurately to the lines and grades as shown on the Drawings.

01.04.02 Inspection of Parts of the Work by Permit Agencies

Inspection of that part of the Work requiring special permits from agencies such as road commissions, drain commissions, railroads, Michigan Department of Transportation (MDOT), and the Michigan Department of Environmental Quality (EQLE) may be performed by that agency. The cost of inspection of special permit work by agencies other than the Owner shall be at the Contractor's expense.

01.04.03 Inspection by Owner

The Engineer and his representatives shall at all times have access to the Work. In addition, authorized representatives and agents of any participating federal or state agency shall be permitted to inspect all Work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records. The Contractor shall provide proper facilities for such access and observation of the Work and also for any inspection or testing thereof.

If any Work is covered without prior inspection or contrary to the instructions of the Engineer, it must, if requested by the Engineer, be uncovered for his observation and replaced at the Contractor's expense.

If the Engineer considers it necessary or advisable that Work previously approved for covering be inspected or tested by others, the Contractor, at the Engineer's request, will uncover, expose, or otherwise make available for observation, inspection, or testing as the Engineer may require, that portion of the Work in question, furnishing all necessary labor, materials, tools, and equipment. If it is found that such Work is defective, the Contractor shall bear all the expenses of such uncovering, exposure, observation, inspection, and testing of satisfactory reconstruction. If, however, such Work is not found to be defective, the Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Time, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, and reconstruction. An appropriate Change Order will be issued.

In addition to the inspection required by Permit Agencies, the Owner may provide Engineers and/or Inspectors to inspect the Work performed under this and related Contracts. The Owner has determined that construction and related operations requiring full time inspection are generally defined as follows:

a. General

1. Check for required permits
2. Inspect the plant operations of manufacturers, including batch plants, and/or Suppliers of materials to be incorporated in the Work
3. Check for certification and Engineer approval of all materials and equipment (including compliance with approved Shop Drawings) delivered to the job site
4. Attendance at preconstruction meeting and construction progress meetings
5. Review of Contractor's payment requests
6. Preparation and review of Field Orders and Change Orders
7. Witness all final inspection of Work
8. Restoration of conditions existing prior to construction, including drives, sidewalks, fences, landscaping, cleanup, etc.
9. Resolution of construction complaints, including the viewing of audiovisual record of construction area
10. Construction of appurtenances
11. Preparation of Punch Lists
12. Change plans to as-built conditions

b. Streets and Roads

1. Excavation and preparation of the site
  - (a) Salvage of gravel or base material
  - (b) Construction of compacted fills
  - (c) Construction of ditches and swales
  - (d) Replacement and compaction of roadway surface gravel
2. Subbase construction
3. Base construction
4. HMA placement

c. Water Mains

1. Excavation, bedding, and backfill
2. Tunneling, jacking, and boring
3. Installation of materials
4. Pressure testing and disinfecting
5. Structure Adjustments

d. Sewers and Drains

1. Excavation, bedding, and backfill
  2. Tunneling, jacking, and boring
    - (a) Shaft construction
    - (b) Mining
    - (c) Forming
    - (d) Placement of concrete
- (NOTE: Two inspectors are required to be present at each tunnel site; 1 in the tunnel and 1 topside)
3. Installation of materials
  4. Witness TV inspection of sanitary sewers
  5. Final inspection of underground facilities and utilities
  6. Structure Adjustments

e. Buildings and Structures

1. Excavation and earthwork
2. Construction of sheeting, shoring, and bracing related to construction
3. Inspect the delivery and storage of materials and equipment
4. Construction of foundations
5. Placement of reinforcing steel
6. Placement of concrete
7. Backfilling and compaction
8. Inspection of all building related Work including process, electrical, mechanical, and instrumentation work
9. Installation, testing, and start-up of equipment
10. Final cleanup and site work

The Contractor shall notify the Owner or the Engineer and the affected permit agency 24 hours in advance of any Work to be performed on the Project.

The Owner will provide inspection of the Project up to the "Completion Date as Bid" determined in the Notice to Proceed at no cost to the Contractor.

However, the Contractor shall reimburse the Owner the cost of inspection of work performed after said Completion Date at the rate per Inspection day shown in the Proposal.

An Inspection-day is defined as 1 construction operation requiring 1 full-time Inspector for 8 hours. Partial days or overtime hours will be computed as follows:

|                            |  |
|----------------------------|--|
| Through 4 hours/day        | ½ inspection-day                       |
| Over 4 through 8 hours/day | 1 Inspection-day                       |
| Over 8 hours/day           | 1/6 Inspection-day/hour                |
| Holiday or weekend         | 1/6 Inspection-day/hour (min. 4 hours) |

01.04.04 Construction Contract Administration by Owner's Representative

During the execution of the Work, the Owner will provide one, or more, Representatives designated to perform Construction Contract Administration (CCA). These Representatives will make periodic visits to the Project site to observe the progress and quality of the executed Work and will determine in general if the Work is proceeding in accordance with the Contract Documents. CCA time will be supplemental to Inspection time; therefore, it is not intended that CCA will include exhaustive or continuous onsite inspections to check the quality and quantity of the Work. Nor will CCA by the Owner's Representatives assume any of the Contractor's responsibility for the construction means, methods, techniques, sequences, procedures, or safety precautions incidental thereto or the Contractor's obligation to perform the Work in accordance with the Contract Documents. The intention of CCA is to provide assurance to the Owner that the Work is executed, and when completed will conform essentially to the requirements of the Contract Documents.

Every eight man-hours of CCA time will be considered a "CCA-day". The cost of CCA time will be based on the number of "CCA-days" expended to perform this function by the Owner's Representative.

Until the Completion Date as Bid, the Owner will provide, at no cost to the Contractor, the CCA time required to perform the normal CCA described as follows:

- Preliminary review and approval of Audiovisual Tape Coverage of the construction area
- Original review of Shop Drawings
- General contract correspondence
- The negotiation and preparation of Field orders and/or Change Orders originated by the Owner or his Representatives
- Review and approval of construction progress schedules
- Attendance at preconstruction meetings and progress meetings scheduled under this Contract
- The resolution of citizen complaints caused by construction operations done in accordance with the Contract Documents

However, the actual amount of time required for CCA may be largely determined by the Contractor's organization of the Work and his efficiency. All CCA time consumed for work that is not included in the above-listed normal categories shall therefore be paid for by the Contractor at the cost per CCA-day shown in the Proposal. These general categories of CCA time, for which the Contractor will be back-charged, will include, but are not necessarily limited to, the following:

- All CCA-days consumed after the established "Completion Date as Bid"
- Re-review of Shop Drawings
- Any site visits by the Owner's Representatives that are required to resolve construction conflicts directly caused by, or the result of, the Contractor's activities
- The resolution of citizen complaints caused by construction operations not done in accordance with the Contract Documents
- Negotiation and preparation of Field Orders and/or Change Orders originated by the Contractor
- Any job related meetings other than those normally scheduled under this Contract

#### 01.04.05 Materials Testing & Inspection

All materials and equipment used in the construction of the Project shall be subject to adequate inspection and testing in accordance with generally accepted standards, as required and defined in the Contract Documents. Material tests and inspection may be made by the Engineer or his authorized representative during manufacture and/or upon delivery. All material rejected after delivery shall be removed from the job site within 5 days after notification of rejection. The Contractor shall pay all costs for such removal and replacement with acceptable material, including all handling, loading, and transportation charges.

The Owner will provide, at his expense, the testing services required by the Contract Documents. The Contractor shall pay for all re-testing. Invoices for Material Testing will be submitted to the contractor for reimbursement (see Special Provision for Material Testing).

If the Contract Documents, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction require any Work to specifically be inspected, tested, or approved by someone other than the Owner, the Contractor will give the Engineer timely notice of readiness. The Contractor shall then furnish the Engineer the required certificates of inspection, testing, or approval.

Inspections, tests, or approvals by the Engineer or others shall not relieve the Contractor from his obligations to perform the Work in accordance with the requirements of the Contract Documents. Approval of any material or equipment shall be only for the characteristics of uses named in such approval and shall not constitute a change or modification of the Contract or a waiver of the Owner's right to demand full compliance with the Drawings and Specifications.

When materials or equipment have been approved, no change or substitution will be permitted.

## 01.05 TEMPORARY FACILITIES

### 01.05.01 Soil Erosion and Sedimentation Control

The Contractor shall construct this Project in compliance with part 91 of Act No. 451 of 1994 (being Section 324.9101 of the Michigan Compiled Laws entitled "Soil Erosion and Sedimentation Control") under the control of the local permit agency charged with administering the provisions of this Act. The Contractor shall follow the procedures delineated below and construct and maintain the facilities shown on the Drawings to control water and wind erosion during construction of this Project.

All disturbed surface areas (including utility trenches) shall be temporarily graded and/or ditched to direct all water runoff from such areas to sedimentation control devices so as to prevent water carrying soil from entering a watercourse, sewer, or adjacent lands. Such sedimentation control devices shall include, but not be limited to: protective ditches, sediment traps, sediment filters, ditch traps, pipe barriers, straw bale berms, and filters, as detailed and required and located on the Drawings. After the Project Work has been completed, inspected, and approved, the Contractor shall remove all sedimentation control devices, material, and their collected silt and debris and complete the Project Work in accordance with the Drawings.

In roadway areas temporary aggregate surfacing shall be placed immediately after the backfilling operation has been completed. Positive dust control measures shall be taken at all times.

Within 15 days from the date a Project improvement is installed, the Contractor shall proceed with final cleanup and restoration of the Project area disturbed (including spill areas) and complete such operations within the next 15 days. If seasonal conditions prevent final cleaning and restoration, the Contractor shall proceed with temporary stabilization of the disturbed area. Final cleanup and restoration shall consist of final grading, top soiling, seeding and mulching, and/or sodding of all disturbed areas of the Project. Temporary stabilization shall consist of rough grading the disturbed area to a condition ready to receive topsoil, seeding with 70 pounds per acre of perennial rye grass, and mulching the disturbed area in accordance with these Specifications. Temporary stabilization materials shall be removed and disposed of and final cleanup and restoration shall be completed no later than 60 days after seasonal conditions allow performance of the required Work.

### 01.05.02 Siltation and Erosion Control at Stream Crossings

The Contractor shall comply with the following excerpts from the Michigan Department of Natural Resources Specifications for erosion and siltation control at stream crossings. All costs in connection with these requirements shall be borne by the Contractor and shall be considered as incidental to the Contract.

The Owner shall secure required permits from the EQLE for all stream crossings and the Contractor shall pay the cost of any inspection charges by that agency for Work done under those permits.

#### a. Notice for Inspection

The Contractor shall give 10 days notice to the Engineering Division of EQLE before the beginning of Work so that arrangements can be made for field inspection by the Department.

b. Notice of Work Adjacent to a Stream

Five days notice of crossing or ditching within 50 feet of any stream shall be given to the EQLE Engineering Division.

c. Prevention of Damage to Fish and Wildlife Habitat

The Contractor shall take necessary steps in carrying out the Contract to prevent damage to fish and game habitat, and to preserve the natural resources of the state. Excavation shall be carried out so as to prevent discharge of damaging material into any stream, lake, or reservoir.

d. Time of Construction

Construction Work across major streams shall be done following special weekend holidays (Memorial Day - Labor Day) rather than just before and during such times.

e. Need for Expeditious Completion of Work

The work of clearing, grading, ditching, backfilling, and final cleanup in close proximity to streams, lakes, and reservoirs shall be completed as soon as possible in order to prevent erosion occurring from wind and precipitation.

f. Settling Basins

Temporary settling basins may be required at some crossings. Settling basins when required shall be constructed prior to any other Work at the site crossing. Cofferdams will be in the same category. Cold water streams will in most cases require this type of treatment.

g. Cofferdams

Cofferdams are to be removed, including any materials trapped by them in the control of siltation. Intermittent removal of silt or sand during construction may be required for proper operation of settling basins.

h. Trench Excavation

All pipe trenches shall be excavated to a depth that will provide a minimum depth of 30 inches from bed of stream to top of pipe.

Appropriate trench excavation methods shall be employed to minimize the entry of material from the trench into the stream, giving due consideration to the soil, terrain, cover, side slope, and weather conditions involved.

The pipe trench excavation shall stop some distance from the stream to leave a 10 to 20 foot long protective plug of unexcavated material at each bank. These plugs shall be left in place until the pipe laying operation across the stream is begun.

Trench excavation across the stream shall be done first. The landward portion of the plug shall be next. The plugs shall not be completely removed until absolutely necessary. They shall be protected from ditch erosion by sheet piling, sandbagging, or side cut diversion openings.

Earth plugs shall be replaced on each bank as soon as the pipe is laid and protected, as specified above.

The trench in the stream bed shall not be backfilled except where necessary to provide a foundation for the stream bank riprap, or to protect the pipe line from possible damage by partially filling the trench with coarse aggregate. In no event shall any type of backfill be used which will cause excessive siltation.

Construction water shall be prevented from entering the stream by construction of diversion ditches or by pumping water from trench excavations to appropriate sedimentation basins on private lands secured from land owners.

i. Final Cleanup

Final cleanup shall consist of reshaping the stream to its original configuration, width and depth and bottom material; protection of the stream banks as specified and removing all construction material and debris from the crossing site, including any material and debris deposited downstream from the site as a result of the pipeline construction. Exposed beds and banks of streams shall not remain unprotected over 7 days.

j. Stream Bank Protection

All disturbed stream banks with raw soil exposure shall have a finished slope no steeper than one on two (one vertical to two horizontal) to prevent sloughing until stabilized by vegetative cover or riprap. The one on two slope shall be graded back to the top of the natural bank. If the top of the natural bank is more than 3 feet above the high-water line, a 10 foot berm may be placed at this level and the remaining slopes constructed upward parallel with the natural bank.

All raw soil exposed above the water line shall be sodded, riprapped, or seeded, fertilized, and mulched with Type 5S-1S Emulsion.

Mulch is to consist of 3 inches of straw or other approved material. Mulch on slopes greater than 10 percent shall be held in place by a spray of asphalt Type SS-1 S Emulsion mixed with an equal amount of water.

Seeding and fertilizing rates shall be as follows: Fertilizer - 200 lbs. of 6-24-24 per acre; Seed - 10 lbs. Kentucky 31 fescue, 3 lbs. Birdsfoot trefoil, and 3 lbs. white clover per acre.

At crossings through or near stream bends permanent riprap shall be used from the stream bed up to the high-water line. Permanent riprap shall also be used on any disturbed stream bank where the stream velocity measured within 10 feet of the bank is greater than 5 feet per second. Permanent riprap shall be 5 to 1 mix of sand, to cement in burlap or canvas bags. Sackcrete may be used instead of the above mix.

At crossings on straight sections of streams permanent type riprap shall be placed along the stream bank from the stream bed up to an elevation 2 rows of riprap above the normal water line. Sandbags shall be placed from this elevation to the high-water line.

Deflection dikes reinforced by 1 row of sandbags shall be used to divert runoff from steep slopes to undisturbed areas adjacent to the right-of-way where the contributing runoff could be great enough to cause slope erosion.

These dikes shall be placed along the top of all stream banks where the entire slope is not protected with riprap. They shall also be placed at the top of and at 100 foot intervals or less on slopes greater than 20 percent.



#### 01.05.03 Temporary Access Roads and Drives

The Contractor shall, where necessary, construct and maintain temporary access roads and drives as directed by the Engineer.

These roads and drives shall serve as access for local public or private use or as access to the construction site both for the Contractor's equipment and for the delivery or removal of materials.

The temporary access roads and drives shall be removed by the Contractor when directed by the Engineer. The areas shall be restored as near the condition found as is practical and shall be compatible with the adjacent undisturbed areas.

#### 01.05.04 Traffic Control

Facilities shall be provided along the route adjacent to the Work in progress as necessary to maintain both local pedestrian and vehicular traffic that is dependent solely upon such route for access to adjacent property. Closing of any street to through traffic, even if just temporary, may be done, if at all, only as specifically authorized by the governing agencies. Unobstructed access to fire hydrants and water and gas valves shall always be provided.

Where any street is to be partially blocked, temporary roadways, sidewalks, bridges, crossings, barricades, lights, signs, and the like shall be provided and maintained as the Engineer considers necessary to accommodate and protect the public. Should the Contractor fail to promptly provide or neglect to maintain the required temporary facilities, or be dilatory in carrying out specific instructions of the Engineer, those having authority may, with or without notice to the Contractor, take such remedial measures deemed necessary and charge the Contractor with any costs incurred therefore. Any such action, however, shall in no way serve to release the Contractor from his general or particular liability for the safety of the traveling public or the protection of property.

Where street obstruction is authorized, the Contractor shall inform the Municipal Fire Department in advance of such obstruction, so that plans may be prepared for servicing the area. He shall, likewise, notify the authorities having jurisdiction over the streets and roads at least 1 week prior to the contemplated obstruction so that regulatory traffic controls may be arranged.

In the event the Contractor is authorized to close the road to all traffic, it will be the responsibility of the Contractor to notify the local police department, the governing agency, local fire department, local school board, and residents on the road affected by the road closure. Furthermore, it will be the Contractor's responsibility to provide any temporary facilities required by the local governing authorities due to the temporary closing of the road, and to obtain permits prior to closing any road.

All traffic signs or traffic lights disturbed or damaged during the construction of the Project shall be replaced in their original condition. Any traffic sign or light temporarily disturbed or removed during construction shall be replaced with temporary signs or flagmen during construction in the immediate area and then permanently replaced immediately after construction in that area is essentially finished. The cost of this replacement shall be incidental to the Project and no separate payment will be made therefore.

#### 01.05.05 Pumping, Maintaining Sewage Flow, and Drainage

Adequate pumping and drainage facilities shall be provided, and all water from whatever sources entering the Work during any stage of construction shall be promptly removed and disposed of. All pumping and drainage shall be done without damage to property or structures and without



interference with the rights of the public, Owners of private property, pedestrians, vehicular traffic, or the Work of other Contractors. Dewatering shall be done in such a manner that the soil under or adjacent to existing structures shall not be disturbed, removed or displaced.

The overloading or obstructing of existing drainage facilities will not be permitted and the Contractor shall be solely responsible for damage caused by his operations.

Both dry weather sewage flow and storm flows in all existing sewers, ditches, streams, rivers and drains, which may in any way be affected by the new construction, shall be adequately maintained. Only such methods shall be used in maintaining flows as will prevent raising the levels of the sewage in upstream sewers to the extent to cause basement flooding or other damage. All gutters, ditches, catch basins, and other surface water inlets and drains shall be kept clear for proper surface drainage. Surface water inlets and drains that interfere with the Contractor's operations shall be temporarily altered or relocated by the Contractor as directed or approved by the Engineer.

The Contractor shall take all necessary precautions to assure that no raw sewage is bypassed to a receiving stream as a result of his operations.

All alterations, relocation, or use of any existing facilities shall be approved by the proper governing agency and shall be restored to the original location, and to as good a condition as found; all as approved by the governing agency.

Should the Contractor desire to place or remove any restrictions (such as bulkheads, curtain walls, dams, sandbags, or flumes) or to leave temporary openings in any sewer wall, approval shall first be obtained from the Engineer. Any temporary obstruction so placed shall be promptly removed when no longer needed. Any temporary opening made in an existing sewer structure shall, likewise, be promptly closed when no longer needed. Such closure shall be made as directed by the Engineer to provide structural and hydraulic conditions equivalent to those originally existing.

Should flooding or damage to construction Work result from storm conditions, the Contractor will not be entitled to any extra compensation for such loss as he may sustain, or for the extra Work that may result therefrom.

#### 01.05.06 Temporary Sanitary Facilities

The Contractor shall provide and maintain during the life of the Contract sanitary conveniences for the use of all persons employed on the Work, including his Subcontractors, in sufficient number, in such manner and at such places as shall be approved by the Engineer, and all persons connected with the Work shall be obligated to use them. The Contractor shall prohibit the committing of a nuisance within the Work or upon lands about the Work. Any employee found violating these provisions shall be discharged and not again employed without the written consent of the Engineer.

In addition, the Contractor shall provide separate sanitary conveniences for the use of the Engineer and Inspectors. This facility shall be located at the site designated for the Inspector's field office.

The facilities shall be maintained in a sanitary condition, frequently cleaned and disinfected, and promptly removed from the site when directed by the Engineer.

#### 01.05.07 Project Sign

When required by the Supplemental Specifications, the Contractor shall provide, erect, and maintain in good condition throughout the life of the Project, a Project Sign in the location selected by the Owner. The Project Sign shall be constructed in accordance with the following Specifications:

- Size: 4 feet x 8 feet
- Material: The panels shall be exterior type high density overlaid 3/4 inch plywood. The frame shall be 1-1/4 inch by 4 inch fir dressed on all 4 sides.
- Assembly: 1-1/4 inch by 4 inch fir frame to fit 4 foot by 8 foot by 3/4 inch plywood panel with 2 center braces.
- Mounting: The sign shall be mounted to 4 inch by 4 inch wood posts with four 3/8 inch bolts and nuts including washers on each side of the sign.
- Erection: The 4 inch by 4 inch posts shall be set in concrete 12 inches in diameter to a depth of 3 feet below grade.
- Paint: The face of the panel shall receive 3 coats of exterior enamel (sprayed). The rear of the panel shall receive 1 coat of exterior enamel (sprayed). The frame and posts shall receive 3 coats of blue exterior enamel.
- Lettering: Silk screen enamels where possible or hand painted enamels.

The information to be shown on the Project Sign, and the format to be used, will be provided by the Owner after the award of the Contract.

#### 01.05.08 Bulkheads

Bulkheads shall be built or removed at locations shown on the Drawings. Other complete or partial bulkheads or temporary dams may be built as an aid to the construction operations when approved as to location, type and size by the Engineer. Such bulkheads or dams shall be removed prior to the completion of the Work, or when directed by the Engineer.

A brick bulkhead, with the natural soil removed is not designed to withstand air pressures. If air is being used in a tunnel approaching an existing brick bulkhead the pressure shall be reduced or entirely removed. If air pressure is being used in the tunnel or in the adjacent section, then a reinforced concrete bulkhead, designed to withstand 25 psi air pressure or as specified by the Engineer, shall be constructed in place of a brick bulkhead.

The cost associated with the construction of bulkheads shall be incidental to the Contract unless otherwise specified in the Supplemental Specifications.

#### 01.05.09 Air Quality and Ventilation

Means and equipment shall be provided as may be required for detection of and protection against gas encountered in the Work and to safeguard the men employed. Such means and equipment shall comply with all applicable requirements of the United States Bureau of Mines and the U.S. Department of Labor.

In any shaft, tunnel, sewer, or excavation, a positive and approved means shall be provided for testing the air quantitatively for carbon monoxide, nitrogen dioxide, flammable or toxic gases, dusts, mists, fumes, and oxygen deficiency. If gas above allowable limits is encountered, the men shall be ordered to withdraw from the shaft, tunnel, sewer or excavation. Ventilating equipment of sufficient capacity and suitable type to adequately and quickly dilute the gas shall be promptly installed and operated. Gas in gas pockets shall be removed by bleeders to the main exhaust line of the

Ventilating system till such time that the gas pocket is sealed off. The men shall not return to Work until the shaft, tunnel, sewer, or excavation has been thoroughly examined for harmful or dangerous gas and oxygen deficiency and found to be within the allowable limits. Suitable signs shall be conspicuously placed at hazardous locations prohibiting smoking and the use of open flame.

No open flame or other open light shall be used in the tunnels, shafts, sewers, or gas producing excavations to which entry is necessary. Should an open flame be necessary for Work such as cutting existing steel and the like, it shall be used only after satisfactory gas test and as limited by the authorization of the Engineer.

Such regulations shall be rigidly enforced by the Contractor and he shall promptly discharge any employee who violates such safety requirements.

#### 01.05.10 Temporary Utilities

Except as specifically noted, the Contractor shall furnish and pay for all required labor, materials and equipment, tools, construction equipment and machinery, samples, shipping costs and tests, all necessary utilities, such as water, electric power, telephones, roads, fences, and sanitary facilities, including maintenance thereof, and any other facilities and services necessary for proper execution and completion of the Work.

#### 01.05.11 Materials and Equipment Storage on Site

Materials and equipment shall be so stored as to insure the preservation of their quality and fitness for the Work. When considered necessary, they shall be placed on wooden platforms or other hard, clean surfaces, and not on the ground, and/or they shall be placed under cover. Stored materials shall be located so as to facilitate prompt inspection. Private property shall not be used for storage purposes without the written permission of the Owner or lessee.

All materials and equipment shall be handled in a manner to avoid damage or breakage and delay in the completion of the Work. The Contractor shall repair or replace, without cost to the Owner and to the satisfaction of the Engineer, all items damaged or broken as a result of his operation.

All materials shall be so delivered, stored, and handled as to prevent the inclusion of foreign materials and/or damage by water, breakage, or other causes. Packaged materials shall be delivered in original unopened containers and shall be stored until ready for use. Packages or materials showing evidence of damage or contamination, regardless of cause, will be rejected. All materials which have been stored shall be subject to retest and shall meet the requirements of these Specifications at the time they are used in the Work and at the time of final acceptance of the Work.

All materials to be incorporated in the Work shall be properly arranged, covered, and protected and the Contractor shall be solely responsible for the safety of the same. Material improperly stored shall not be included in estimates for partial payment, or if already included, shall be deducted for subsequent estimates.

Private property shall not be used for storage purposes without written permission of the Owner or lessee.

#### 01.05.12 Fences, Mailboxes and Other Physical Features

All fences, mailboxes and other physical features disturbed or damaged during the Work under this Contract shall be maintained and if damaged, repaired or replaced in a workmanlike manner with materials satisfactory to the property owner affected and the Engineer. In addition, the Contractor shall furnish, erect and maintain any temporary construction fencing required during the performance of the Work or ordered by the Engineer.

#### 01.06 EXISTING PROPERTIES, STRUCTURES, AND UTILITIES

##### 01.06.01 Notification of Governing Agencies and Utilities

At least a week in advance of beginning Work, the Contractor shall notify all public bodies and other Owners of such facilities of the proposed location of his operations, advising them that their property may be affected and that such measures as they may deem necessary should be promptly taken to protect, adjust, remove and/or rebuild them.

##### 01.06.02 Preservation of Property, Trees, Monuments, etc.

The Contractor shall be responsible for the preservation of all public and private property affected by operations within his control. He shall use the precautions necessary to prevent damage or injury thereto. All such protective and corrective work shall be in accordance with the Contract Documents.

The Contractor shall be responsible for the damage or destruction of property of any character resulting from neglect, misconduct, or non-execution of the Work, or caused by defective work or the use of unsatisfactory materials.

The Contractor shall not injure or destroy trees or shrubs nor remove or cut them without authorization by the Owner. All trees and shrubs except those ordered to be removed shall be adequately protected by boxes or otherwise by the Contractor. No excavated material shall be placed so as to injure such trees and shrubs. Trees and shrubs destroyed by negligence of the Contractor or his employees shall be replaced by him with new stock, or with other stock satisfactory to the Owner, at the proper season, and at the sole expense of the Contractor.

Parkways shall be left in as good condition as before the commencement of the Work. Where sod is removed, it shall be carefully preserved and later replaced with sod of equivalent quality.

When or where any direct or indirect damage or injury is done to public or private property resulting from the Contractor's operations, such property shall be restored by the Contractor, at his expense, to a condition similar or equal to that existing before commencement of his work.

##### 01.06.03 Cleanliness of the Project

The Contractor shall keep the Work area and all property occupied by him in a neat and orderly condition at all times. Waste materials, rubbish, and debris shall not be allowed to accumulate. The Contractor's equipment, temporary buildings, scaffolding, and excess materials shall be promptly removed as they become no longer needed for the progress of the Work. At the completion of the Work, the Work area shall be restored to as good as, if not better than, that prior to construction.

If, in the opinion of the Engineer, cleanliness of the Project is not progressing in a reasonable manner, he shall have the right to direct the Contractor to proceed with such Work, or any portion thereof, immediately. In the event the Contractor does not then immediately proceed with this Work, the Engineer may order any or all other operations of the Contractor, under this Contract, to cease until the cleanliness of the Project is proceeding in an acceptable manner.

#### 01.06.04 Truck Routes

The Contractor shall work with the appropriate government agency(ies) in determining truck routes on this Project and shall have such routes approved by the same before the routes can be used. It may further be required that truck routes be audio visually taped before, during, and after construction by the Contractor when so requested by the Engineer. It shall thereafter be the responsibility of the Contractor to maintain the truck routes for the period of time such routes are used by the Contractor.

The Contractor shall keep clean all streets used in his operations. Trucks hauling materials, cement, sand, stone, or other loose materials from or to the site, shall be tight so that no spilling will occur. Before trucks start away from the site, their loads shall be carefully trimmed to prevent spillage.

The above requirements likewise apply to Suppliers making deliveries to the site, and the Contractor will be held responsible for compliance by his Suppliers.

#### 01.06.05 Rights-of-Way and Easements

All available rights-of-way and easements have been shown on the Drawings. If the Contractor requires additional easements for his construction operations he shall obtain such easements and furnish copies of such to the Owner and Engineer. In carrying out the Work within private rights-of-way and easements, the Contractor shall take due and proper precautions against any injury to adjacent properties and structures and shall comply with the conditions outlined in the easement and/or right-of-way Agreements included in the Contract. Prior to performing any Work, the Contractor shall obtain any required permits and furnish bonds that may be required to construct within any public right-of-way.

#### 01.06.06 Highway and Street Requirements

The highway and street requirements contained herein shall be considered requirements for the use of both public and private roads in this Project. All costs in connection with these requirements shall be borne by the Contractor and shall be considered as incidental to the Project.

Snow fencing, unless otherwise specified, shall be the minimum provided to preclude the entrance of the public into the construction area. Where the construction disrupts or interferes with the normal walkways used by pedestrians, they shall be duplicated in kind so that pedestrians may traverse the construction area safely.

Trench excavation shall be done so as to minimize interference to the operating roadway and where trench sides are within 5 feet or closer to the traveled portion of the roadway, bypasses shall be constructed. All signing construction of bypasses, and construction of permanent restoration shall be in accordance with the governing agency, municipality, or MOOT Specifications.

In all primary roads where open cut crossings will be made, the Contractor shall submit Plans for re-routing of traffic to the Road Commission or Municipal Traffic Engineer for approval before proceeding with construction across primary road.

The Contractor shall rough grade, and open, road ditches and other waterways every night before closing down the job.

Existing ditches disturbed during construction shall be re-ditched in the location and to the cross section, as determined by the Engineer prior to final grading. The cost of such re-ditching shall be incidental to the Project and no separate payment will be made therefore.

Materials and equipment shall not be stockpiled within the right-of -ways so as to obstruct or cause a problem to any driveway or side street.

All obstruction within 8 feet of pavement edge shall be lighted from sunset to sunrise.

If it is necessary to direct motorists more than 3 feet laterally, street lighting shall be provided.

Temporary pavement parking, in addition to signing, shall be required at all lateral displacements of traffic. The placing of the pavement markings, the covering of the old lines, and restoration shall be performed by *the* Contractor in accordance with the governing agency's requirements.

The Contractor shall maintain the traveled portion of the roadway clear from mud, dirt, debris, and other materials. The Contractor shall maintain the road surface in the working area safe for the motoring public, shall salt when hazardous ice or snow conditions require it, and shall chloride the roads to alleviate dust conditions engendered by his operations whenever necessary.

All signs, lighting, and other necessary safety requirements shall comply with the governing agency and the state highway department Specifications. In addition, the Contractor shall take all necessary precautions as directed by the governing agency as are deemed necessary to protect the public.

Unless otherwise indicated in the Supplemental Specifications, the Contractor shall pay all permit fees and inspection charges for Work performed by all governing agencies, the MDOT and railroads.

#### 01.06.07      Work Within Railroad Rights-of-Way

All Work within railroad rights-of-way shall be conducted in accordance with the requirements of the railroad company having jurisdiction over the right-of-way.

The Contractor, to protect his and the Owners interest, shall keep a detailed record of all services and materials furnished by the railroad. Daily reports of such Work and material should be signed both by the Owner's Inspector and any representative of the railroad present on the Project. Seventy-two hours notice, exclusive of Saturdays, Sundays, and holidays, shall be given to the railroad superintendent before any Work is performed within a railroad right-of-way. Since the railroad requires that all Project communications be forwarded through the Owner, the Contractor shall notify the Owner sufficiently in advance to allow him to make necessary arrangements with the railroad.

#### 01.06.08      Overhead Utilities

All utility poles and overhead lines may not be shown or identified on the Drawings. The Contractor shall make his own determination of existing utility poles and facilities attached thereto and overhead lines. Where overhead utilities are encountered in the Work, Contractor shall arrange with the utility Owner for the necessary relocation or protection of their facilities. Protection, removal and replacement, tunneling or supporting of existing utility poles and protection and removal and replacement of utilities which are installed on the poles shall be provided either by the Contractor or by the utility at the Contractor's expense, all in accordance with requirements of the utility owner.

#### 01.06.09 Underground Utilities

All underground utilities as shown on the Drawings have been plotted utilizing the best information available. Prior to excavating in any area, the Contractor shall notify MISS DIG or the involved utility companies and request verification of the utility locations as shown. Any variances in location which occur shall be brought to the attention of the Engineer prior to the commencement of any digging operations. In the event that the installation of a proposed utility is depended upon knowing the exact elevation or location of any existing utility, the Contractor shall excavate and locate such utilities in advance of the Work and inform the Engineer of their exact location.

Should the Contractor discover conflicts that exist between the location of the existing utility and those proposed, he shall notify the Engineer in writing in advance of any Work so that adjustments can be made.

Where underground utilities are encountered in the Work, the Contractor shall arrange with the utility owner for any necessary protection or relocation of their facilities.

All protection, maintenance of service, removal and replacement etc., shall be in conformance with the requirements of the utility owner. Protection, maintenance of service, removal and replacement, and supporting of existing underground utilities, shall be provided by the Contractor or by the utility at the Contractor's expense unless relocation or removal and replacement of certain utilities are specifically covered by a separate pay item in the Proposal.

#### 01.06.10 Structures

The Contractor shall assume full responsibility for the protection of all buildings, utilities, or other structures and their foundations, as well as other improvements, such as pavement, etc., that might be encountered during, or affected by, his operations. Should settlement or lateral movement of adjacent structures or surface features occur, such conditions shall be rectified at the Contractor's expense. If damage to any structures, utilities, or other improvements occurs by reason of the Contractor's operations, even though special precautions have been employed, the Contractor shall be entirely responsible for such damage.

### 01.07 PROJECT CLOSE OUT

#### 01.07.01 Final Inspection of the Completed Work and Engineer's Punch List

When the Contractor considers the Work to be complete he shall submit written certification to the Owner (copies should be forwarded to Engineer, and governing agency representatives) that:

1. The Contract Documents have been reviewed in reference to the completed Work.
2. All Work has been completed in accordance with the Contract Documents or written clarification and modifications thereof.
3. All equipment and systems have been tested in the presence of the Owner's Representative and are operational in the manner set forth in the plans and/or specifications.

#### 01.07.02 Contractor's Close Out Submittals

When the Engineer finds that the Work is acceptable and conforms to the Contract Documents, the Contractor shall make the following close out submittals:

1. Evidence of compliance with requirements of governing agencies
2. Operation and maintenance data

3. Record documents
4. Keys and key schedule
5. Guarantees
6. Spare parts and maintenance materials

Final request for payment with supporting data (i.e. Contractor's Declaration, Contractor's Affidavit, Release and Waivers of Liens, Agencies' Releases, etc.).



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PROGRESS CLAUSE  
FOR  
INDEPENDENCE TOWNSHIP  
CLARKSTON ROAD SAFETY PATH IMPROVEMENTS  
NFE JOB NO. M383-01

**PROGRESS CLAUSE:** The Contractor shall start work within ten (10) days of receiving Notice to Proceed, on or before the date designated as the starting date in the detailed Progress Schedule, as agreed upon by the Owner and Engineer. In no case, shall any work be performed prior to receipt of formal Notice of Award by the Township. The Notice to Proceed will be mutually agreed upon between the contractor and Owner.

The entire project shall be completed on or before May 3, 2024.

The Contractor will be expected to mobilize sufficient manpower and all necessary equipment to meet the completion dates specified above.

Failure by the Contractor to meet the above requirements and dates will result in the Contractor being assessed liquidated damages in accordance with the provisions outlined within the Contract.

Liquidated Damages will be assessed on a project completion basis, pursuant to the conditions of the form of proposal and will continue to be assessed for each calendar day or portion of a day that this work remains incomplete.

The Contractor will be required to meet with the Owner and Engineer and to submit a detailed Progress Schedule. The Engineer will arrange the time and place for the meeting. The named subcontractor(s) for designated and/or specialty items, as shown in the proposal, is / are recommended to attend the preconstruction meeting if such items materially affect the work schedule.

NOTICE TO BIDDERS  
BUY MICHIGAN / HIRE MICHIGAN

1 of 1

The Contractor is hereby notified that it is the intent of the Township of Independence that a “Buy Michigan / Hire Michigan” initiative be used during the project.

The Contractor shall make a good faith, concentrated effort to initiate a “Buy Michigan / Hire Michigan” provision by employing Michigan residents, subcontracting to Michigan based business and purchase goods manufactured or grown in Michigan, as a part of a competitive commercial bid.

## NOTICE TO BIDDERS

## CERTIFIED PAYROLL

1 of 1

Contractor and all tiers of subcontractors are required to pay no less than the minimum salaries and wages as required by the Minimum Wage Act of 1964 as amended, and that the Contractor must ensure that employees and applicants for employment are not discriminated against because of race, color, religion, sex, or natural origin, in accordance with the Elliot-Larson Civil Rights Act.

In accordance with the Contract, the Engineer reserves the right to request Certified Payrolls of the Contractor and / or subcontractors to verify wage compliance requirements are being met. If requested, payrolls shall be provided as a requirement for progress payments.

## NOTICE TO BIDDERS

### JOB SITE SAFETY

1 of 1

Neither the professional activities of the Engineer, nor the presence of the Engineer or its employees and consultants, shall relieve the Contractor and any other entity of their obligations, duties and responsibilities including, but not limited to, construction means, methods, sequence, techniques or procedures necessary for performing, superintending or coordinating all portions of the work of construction in accordance with the Contract Documents and any health or safety precautions required by any regulatory agencies. The Engineer and its personnel have no authority to exercise any control over any construction Contractor or other entity or their employees in connection with their work or any health or safety precautions. The Contractor agrees that the Contractor is solely responsible for job site safety. The Contractor also agrees, to the extent permitted by law, that the Owner, Engineer and Engineer's consultants shall be indemnified by the Contractor for claims, demands, damages, judgments, losses, interest, attorney's fees, litigation costs and expenses of any kind, at any time, for bodily injury and or property damage, arising out of or in any way connected to the Contractor's work or acts related to the Project. The Contractor also agrees that the Owner, Engineer and Engineer's consultants shall be made additional insured under the Contractor's general liability insurance policy.

## NOTICE TO BIDDERS

### BI-WEEKLY PROGRESS MEETING

1 of 1

Bidders are advised that after the commencement of construction activities, the Contractor will be required to attend a bi-weekly progress meeting with the Engineer and any other interested parties. Dates will be selected at the beginning of the project and the meeting will be held at Independence Township Department of Public Utilities offices, or as otherwise arranged. The Contractor's project representative along with representatives from all critical subcontractors, as requested by the Engineer, shall be present at the meeting to discuss the status of the project and to coordinate the work for the following week.

SPECIAL PROVISION  
FOR  
UTILITY COORDINATION CLAUSE

1 of 1

Description

The following public utilities may have facilities located within the project limits:

|  |   |
|--|---|
| Electric:<br>DTE Energy<br>37849 Interchange Drive<br>Farmington Hills, MI 48335<br>Contact: Sebastian Sarkissian (248) 427-2947   | Telephone:<br>SBC<br>54 North Mill Street<br>Pontiac, MI 48342<br>Contact: Larry Zdan (248)456-0821   |
| Water Main & Sanitary Sewer:<br>Independence Township<br>Water and Sewer Department<br>6050 Flemings Lake Road<br>Clarkston, MI 48346<br>Contact: David McKee (248) 625-8222 | Andersonville Road Right-of-Way:<br>Road Commission of Oakland County<br>2420 Pontiac Lake Road<br>Waterford, MI 48328<br>Contact: Scot Mulholland (248) 858-4835 |
| Cable Television:<br>Comcast Cable Television<br>25626 Telegraph Road<br>Southfield, MI<br>Contact: Ed Buster (248)809-2706  | Natural Gas<br>Consumers Energy<br>1030 Featherstone Road<br>Pontiac, MI 48342  |

On all projects: “Three Working Days before you Dig – Call MISS DIG (800)482-7171”, excluding Saturday, Sunday and holidays.

Owners of public utilities will not be required by the Township to move additional poles or structures in order to facilitate the operation of construction equipment unless it is determined by the Engineer that such poles or structures constitute a hazard to the public or are extraordinarily dangerous to the Contractor’s operations.

The contractor is responsible for the necessary coordination with Consumers Energy to facilitate the installation of the natural gas service. All direct costs to Consumers is eligible for reimbursement.



SPECIAL PROVISION  
FOR  
USE OF TOWNSHIP WATER

1 of 1

Description

Water from the Township water distribution system is available for use by the Contractor. The Contractor MUST apply for and have a permit for water use in the possession of the individual taking the water from the Township system. Unauthorized use will not be permitted. The Oakland County Sheriff's office has been instructed to halt any unauthorized use of water.

The Contractor is advised to contact Mr. David McKee at (248) 625-8222 to ascertain the procedures for obtaining a permit and for paying the required fees for such use.

Measurement and Basis of Payment

The permit fee for water use is the responsibility of the Contractor and shall be considered included in the various pay items of the contract, and shall not be paid for separately.

SPECIAL PROVISION  
FOR  
DUST CONTROL

1 of 1

Description

The Contractor shall take such precautions and do such work so as to effectively control dust caused by his operations on all areas that are affected by the construction of the project.

During each seven (7) day period that the project is under construction, the Contractor shall supply and apply water to the grade in such amounts that dust will be kept to a minimum. The water shall be applied to the grade at least once during each seven (7) day period and at such other times and places as the Engineer may direct. The Contractor shall schedule the application of water to be done on the Thursday of each week. The rate of application shall be 0.5 gallons per square yard.

In the event that the ground is already sufficiently wet from natural causes, the Contractor may not be required to apply water to the grade. The Contractor's equipment and labor to apply the water to the grade shall be on site every Thursday ready and equipped to apply water. The Engineer shall have sole discretion as to whether or not water is required and the Engineer's decision shall be final.

Measurement and Basis of Payment

The completed work for Dust Control shall not be paid for separately and shall be considered included in the various pay items of the contract.

In the event that the Township deems it necessary to perform this work for the Contractor, the Township shall have the work done and charge the cost thereof against any monies that may be due or may become due to the Contractor.

SPECIAL PROVISION  
FOR  
PROJECT COMPLETION AND CLOSEOUT

1 of 1

Description

This provision establishes the procedures and schedule for the completion of deficient / punch list work and timely closeout of the project. This provision does not revise any schedule constraints otherwise indicated within the Contract, nor does it relieve the Contractor and Engineer from properly coordinating the evaluation of completed work and the correction of defects during the general progression of the project.

Procedure

In accordance with the 2020 Michigan Department of Transportation Standard and Specifications for Construction, the Contractor shall submit written notification that the contract work is complete. Following receipt of this, the Engineer will conduct an inspection of the project, and supply the Contractor with a preliminary punch list within five (5) days.

The Contractor shall complete the items listed within the preliminary punch list and notify the Engineer, in writing, that the items have been completed, within fourteen (14) days of receiving the punch list. Following receipt of this, the Engineer and Owner will conduct an inspection of the project, and supply the Contractor with a final punch list within five (5) days.

Failure to complete the items outlined on the preliminary punch list within the schedule noted above will result in the Contractor being assessed 50% of the liquidated damages (per day) in accordance with the Contract, for a maximum of 21 calendar days. Failure to complete the preliminary punch list within the 21 day limit may result in the Owner placing the Contractor in default, in accordance with the Contract.

Failure to complete the items outlined on the final punch list within the schedule noted above will result in the Contractor being assessed 50% of the liquidated damages (per day) in accordance with the Contract, for a maximum of 14 calendar days. Failure to complete the preliminary punch list within the 14 day limit may result in the Owner placing the Contractor in default, in accordance with the Contract.

Upon completion of all final punch list items, the Engineer will have twenty one (21) days to meet with the Contractor, finalize all Contract items and provide the Contractor with a list of final as-built quantities. The Contractor shall have twenty one (21) days, following receipt of the as-built quantity list, to review and respond with agreement or disagreement. If the Contractor disagrees with the quantities presented, they shall provide written justification (calculations, sketches, etc.) to backup their findings. If the Contractor fails to respond within this timeframe, the Engineer will proceed with preparing the final estimate and processing for payment with the Township.

SPECIAL PROVISION  
FOR  
PERMITS

1 of 1

The contractor is hereby notified of the following required permits for the project:

Soil Erosion Control Permit

This permit has been applied for and approved by Oakland County Water Resources. Prior to the commencement of construction, the Contractor shall contact Oakland County and coordinate the pickup of the permit. The Township will pay all permit and inspection fees.

Right-of-Way Permit

A Right-of-Way permit from the Oakland County Road Commission is required for all work proposed within the Andersonville Road right-of-way. Consumers Energy shall be responsible for obtaining a permit for any work in the ROW necessary for the gas service installation.

## SECTION 02 4119 - SELECTIVE DEMOLITION

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.

## B. Related Requirements:

1. Section 31 1000 "Site Clearing" for site clearing and removal of above- and below-grade improvements not part of selective demolition.

## 1.2 DEFINITIONS

- A. Remove: Detach items from existing construction and dispose of them off-site unless indicated to be salvaged or reinstalled.
- B. Remove and Salvage: Detach items from existing construction, in a manner to prevent damage, and **deliver to Owner ready for reuse**.
- C. Remove and Reinstall: Detach items from existing construction, in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain: Leave existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- E. Dismantle: To remove by disassembling or detaching an item from a surface, using gentle methods and equipment to prevent damage to the item and surfaces; disposing of items unless indicated to be salvaged or reinstalled.

## 1.3 MATERIALS OWNERSHIP

- A. Unless otherwise indicated, demolition waste becomes property of Contractor.
- B. Historic items, relics, antiques, and similar objects including, but not limited to, cornerstones and their contents, commemorative plaques and tablets, and other items of interest or value to Owner that may be uncovered during demolition remain the property of Owner.
  1. Carefully salvage in a manner to prevent damage and promptly return to Owner.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property **for dust control**. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's **building manager's** on-site operations are uninterrupted.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Comply with Section 01 3233 "Photographic Documentation." Submit before Work begins.

#### 1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  - 1. Before selective demolition, Owner will remove the following items:
- C. Notify Engineer of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
  - 1. Hazardous materials will be removed by Owner before start of the Work.
  - 2. If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer and Owner. Hazardous materials will be removed by Owner under a separate contract.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
  - 1. Maintain fire-protection facilities in service during selective demolition operations.

#### 1.6 COORDINATION

- A. Arrange selective demolition schedule so as not to interfere with Owner's operations.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Steel Tendons: Locate tensioned steel tendons and include recommendations for de-tensioning.
- D. Verify that hazardous materials have been remediated before proceeding with building demolition operations.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

### 3.3 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
  - 1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  - 2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  - 3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
- B. Temporary Shoring: Design, provide, and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and

finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.
- C. Remove temporary barricades and protections where hazards no longer exist.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly.
- B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, and then remove concrete between saw cuts.



### 3.6 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.
  - 3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
  - 4. Comply with requirements specified in Section 01 7419 "Construction Waste Management and Disposal."
- B. Burning: Do not burn demolished materials.

### 3.7 CLEANING

- A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 4119

## SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings
  - 1. Preinstallation Conference: Conduct conference at Project site.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications
  - 1. 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.
    - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
  - 2. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- B. 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."
- C. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

## PART 2 - PRODUCTS

## 2.01 FORM-FACING MATERIALS

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

## 2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

## 2.03 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 or Type III, gray. Where not exposed as a finished surface in the final construction, supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
  - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

## 2.04 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- 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.

## 2.05 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.06 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

## 2.07 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

## 2.08 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 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.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: As indicated on Drawings at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50, unless otherwise indicated.
  - 3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.09 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.

## 2.10 FABRICATING REINFORCEMENT

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

# PART 3 - EXECUTION

## 3.01 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. Do not chamfer exterior corners and edges of permanently exposed concrete.

## 3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

## 3.03 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  1. Lap joints 6 inches and seal with manufacturer's recommended tape.

## 3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

## 3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- 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.

### 3.06 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. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

### 3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. 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.

### 3.08 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller 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.

### 3.09 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 03 30 00

## SECTION 04 22 00 – Concrete Masonry Unit

### 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. Concrete masonry units.
  - 2. Pre-faced concrete masonry units.
  - 3. Mortar and grout.
  - 4. Steel reinforcing bars.
  - 5. Masonry-joint reinforcement.
  - 6. Embedded flashing.
  - 7. Miscellaneous masonry accessories.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Not required.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315
  - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:



1. CMU.
2. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. CMU.
2. Color mortar. Make Samples using same sand and mortar ingredients to be used on Project.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For masonry units include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 402/602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. 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 402/602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Units similar to:
  1. Grand Blanc Cement Products
  2. Smooth face units
  3. 8"x8"x16" nominal
  4. Color: natural

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
  1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 402/602.
  2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

### 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 402/602 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.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.

1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.4 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.
  2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for all blocks.
  1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
      - 1) Euclid Chemical Company (The); an RPM company.
      - 2) Other approved manufactures.
- C. CMUs: ASTM C 90.
  1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
  2. Density Classification: Normal weight.
  3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.
  4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

## 2.5 MORTAR AND GROUT MATERIALS

- A. Mortar Cement: ASTM C 1329/C 1329M.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Lafarge North America Inc.
    - b. Other approved manufacturer.

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- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterColor (Pre-2014: RHEOCOLOR L) or a comparable product by one of the following:
    - a. Euclid Chemical Company (The); an RPM company.
    - b. Other approved manufacturer.
- C. Colored Cement Products: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Masonry Cement:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cemex S.A.B. de C.V.
      - 2) Essroc.
      - 3) Holcim (US) Inc.
      - 4) Lafarge North America Inc.
      - 5) Lehigh Hanson; HeidelbergCement Group.
      - 6) Other approved manufacturer.
  2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  3. Pigments shall not exceed 5 percent of mortar cement by weight.
- D. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
  - a. Euclid Chemical Company (The); an RPM company.
  - b. Other approved manufacturer.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
    - a. Euclid Chemical Company (The); an RPM company.
    - b. Other approved manufacturer.
- I. Water: Potable.

## 2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, 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 (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dur-O-Wal; a Hohmann & Barnard company.
    - b. Heckmann Building Products, Inc.
    - c. Hohmann & Barnard, Inc.
    - d. Lock Rite.
    - e. Wire-Bond.
    - f. Other approved manufacturer.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.
  1. Interior Walls: Hot-dip galvanized carbon steel.
  2. Exterior Walls: Hot-dip galvanized carbon steel.
  3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
  4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
  5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
  6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

## 2.7 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

## 2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cheney Flashing Company.
    - 2) Hohmann & Barnard, Inc.
    - 3) Keystone Flashing Company, Inc.
    - 4) Sandell Manufacturing Co., Inc.
    - 5) Other approved manufacturer.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.
6. Solder metal items at corners.

- B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

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- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advanced Building Products Inc.
    - 2) Carlisle Coatings & Waterproofing Inc.
    - 3) Fiberweb, Clark Hammerbeam Corp.
    - 4) GCP Applied Technologies Inc. (formerly Grace Construction Products).
    - 5) Heckmann Building Products, Inc.
    - 6) Hohmann & Barnard, Inc.
    - 7) Polyguard Products, Inc.
    - 8) W. R. Meadows, Inc.
    - 9) Williams Products, Inc.
    - 10) Wire-Bond.
  - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.02 mm).
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) DuPont Building Innovations: E. I. du Pont de Nemours and Company.
      - 2) GCP Applied Technologies Inc. (formerly Grace Construction Products).
      - 3) Protecto Wrap Company.
      - 4) Raven Industries, Inc.
      - 5) Wire-Bond.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
  3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hohmann & Barnard, Inc.
      - 2) Hyload, Inc.
      - 3) Mortar Net Solutions.
      - 4) Wire-Bond.
    - b. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.02 mm) thick.
    - c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of adhesive.
    - d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of rubberized-



asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches (38 mm) from edge.

- 1) Color: Tan/buff.
- e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.02 mm) thick.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Carlisle Coatings & Waterproofing Inc.
    - 2) Firestone Specialty Products.
    - 3) Heckmann Building Products, Inc.
    - 4) Hohmann & Barnard, Inc.
    - 5) Sandell Manufacturing Co., Inc.
    - 6) Wire-Bond.
- C. Application: Unless otherwise indicated, use the following:
  1. Where flashing is indicated to receive counterflashing, use metal flashing.
  2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
  4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Mortar Net Solutions.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

## 2.10 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 mortar cement mortar unless otherwise indicated.
  - 3. For exterior masonry, use mortar cement mortar.
  - 4. For reinforced masonry, use mortar cement mortar.
  - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion 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 mortar parge coats, use Type S.
  - 4. 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.
- D. Pigmented Mortar: Use colored cement product.
  - 1. Pigments shall not exceed 5 percent of mortar cement by weight.
  - 2. Mix to match Architect's sample.
  - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Pre-faced CMUs.
    - c. Cast-stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  - 1. Mix to match Architect's sample.

2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 402/602 for dimensions of grout spaces and pour height.
  2. Conventional Grout:
    - a. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
    - b. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C 143/C 143M.
    - c. Mid-Range or High-Range Water-Reducing Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
  3. Self-Consolidating Grout: Proportion grout according to ASTM C 476, for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa). Jobsite proportioning of self-consolidating grout is not permitted. Do not add water at jobsite except according to self-consolidating grout manufacturer's instructions.
    - a. High-Range Water-Reducing Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterGlenium Series (Pre-2014: Glenium Series) or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
    - b. Viscosity-Modifying Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterMatrix VMA Series (Pre-2014: Rheomac VMA Series) or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
    - c. Slump Flow: 24 to 30 inches (600 to 750 mm) as determined in accordance with ASTM C 1611/C 1611M.
    - d. Visual Stability Index (VSI): Less than or equal to 1 as determined in accordance with ASTM C 1611/C 1611M, Appendix X.1.

- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
  - 1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. 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.

#### 3.3 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 (12 mm) or minus 1/4 inch (6 mm).
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) 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 (6 mm in 3 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

### 3.4 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 bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

- F. 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.
- G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
  - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 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. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Wet joint surfaces thoroughly before applying mortar.
  - 3. Rake out mortar joints for pointing with sealant.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth to match existing and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

- G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
- 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.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

### 3.8 LINTELS

- A. Provide steel beam lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

### 3.9 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
  - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  - 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

### 3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.



2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 402/602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 402/602 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 60 inches (1520 mm).

### 3.11 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 C in TMS 402/602 (formerly ACI 530).
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. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

### 3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 06 05 73

PRESERVATIVE TREATED LUMBER AND PLYWOOD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preservative treatment of lumber and plywood.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry - Rough Carpentry.
- B. Section 06 16 00 - Wood Sheathing.

1.3 REFERENCES

- A. American Wood Protection Association (AWPA).
- B. ASTM International (ASTM):
  - 1. ASTM D5564 - Standard Test Method For Determination Of The Total Ammonia Contained In Sulfonated Or Sulfated Oils
  - 2. ASTM E84 - Standard Test Method For Surface Burning Characteristics Of Building Materials
- C. Environmental Protection Agency (EPA)
- D. Federal Standard USA:
  - 1. TT-W-550 - WOOD PRESERVATIVE: CHROMATED COPPER ARSENATE MIXT
  - 2. TT-W-571 - Wood Preservation: Treating Practices
- E. International Building Code (IBC):
  - 1. Section 2304.12 - Wood: Protection Against Decay and Termites.
- F. International Code Council Evaluation Service (ICC-ES).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data:
  - 1. Manufacturer's data sheets on each product to be used.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Typical installation methods.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.

- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

## 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

## 1.8 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Allweather Wood, which is located at: 815 S. 32nd St.; Washougal, WA 98671; Toll Free Tel: 800-777-8134; Email: [request info \(jhewitt@mendoco.com\)](mailto:requestinfo@jhewitt@mendoco.com); Web: <https://www.allweatherwood.com>
  - 1. Additional Manufacturing Facilities:
    - a. Allweather Wood, LLC, 715 Denver Ave., Loveland, CO 80537
    - b. Allweather Wood, LLC, 7893 Pacific Ave., White City, OR 97503
    - c. Allweather Wood, LLC, 880 Kunzler Ranch Rd., Ukiah, CA 95482
    - d. Allweather Wood, LLC, 69015 Hauser Depot Rd., North Bend, OR 97459
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

### 2.2 PRESERVATIVE AND PRESSURE TREATED WOOD LUMBER AND TIMBER

- A. Central Region USA:
  - 1. Plywood:
    - a. Pressure Treatment: Copper Azole Type C (CA-C) CDX Plywood Green Tone.
      - 1) Thickness: 1/2 inches. Size: 4x8 ft.
  - 2. Dimensional Lumber:
    - a. Pressure Treatment: CA-C Douglas-fir. PCF: .15 or .31.
      - 1) Standard and No. 2 Grade or Better Surfaced Four Sides (S4S) and Rough:
        - a) Cross Section: 2x6. Lengths: 8 to 20 ft.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## Section 06 10 00 Rough Carpentry

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section includes general wood framing, nailers, miscellaneous blocking, laminated veneer lumber and pressure-preservative treated wood.

## 1.2 RELATED WORK

- A. 06 16 00 Sheathing
- B. 06 10 00 Rough Carpentry

## 1.3 REFERENCES AND REGULATORY REQUIREMENTS

- A. Appropriate references included in 01090 References.
- B. State of Michigan Building Code, 2015 Edition.
- C. American Forest & Paper Association, WCD1, "Details for Conventional Wood Frame Construction".
- D. ASTM International.
- E. American Wood Protection Association.
- F. Underwriters Laboratories, Inc (UL) – "Fire Resistance Directory".

## 1.4 SUBMITTAL REQUIREMENTS

- A. All submittals shall be in accordance with 01300 Submittals.
- B. ICC-ES evaluation reports for pressure-preservative treated wood.

## 1.5 QUALITY ASSURANCE

- A. In accordance with 01400 Quality Control.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. All wood products shall be delivered to the site in a clean, dry and undamaged condition.
- B. Store off of the ground and protect from the weather.

## PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with the State of Michigan 2015 Building Code.
  - 1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

## 2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWPAC U1; Use Category UC4b for columns and Category UC4a for beams and headers.
  - 1. Use treatment containing no arsenic or chromium.
  - 2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
  - 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- B. Provide preservative-treated materials for all rough carpentry noted below unless otherwise indicated.
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, blocking, furring, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members that are less than 18 inches above the ground.
  - 4. Wood floor plates that are installed over concrete slabs-on-grade.
  - 5. Columns.
  - 6. Lacers.
  - 7. Kickers.

## 2.3 FRAMING

- A. Dimension Lumber:
  - 1. Maximum Moisture Content: 19 percent for 2-inch nominal thickness or less, no limit for more than 2-inch nominal thickness.
  - 2. Non-Load-Bearing Interior Partitions: Construction or No. 2, any species.
  - 3. Framing: Douglas Fir No. 1 or Southern Yellow Pine No. 1: NLGA.
  - 4. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
    - a. Species: As specified for framing other than non-load-bearing interior partitions.
    - b. Grade: Select Structural.

- B. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.
1. Manufacturers:
    - a. Boise Cascade Corporation.
    - b. Georgia-Pacific.
    - c. Louisiana-Pacific Corporation.
    - d. West Fraser Timber Co., Ltd.
    - e. Weyerhaeuser Company.
  2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
  3. Modulus of Elasticity, Edgewise: 1,800,000 psi.
  4. Basis of design: Weyerhaeuser Parallam Plus PSL rated for exterior applications.
  5. All Specified Parallam Plus PSL shall be manufactured and labeled as Trus Joist Products by Weyerhaeuser. Genuine Parallam Plus PSL shall be stamped with reference to the treating standards (AWPA U1), third party quality program monitor, preservative retention, and treater.
  6. Modifications/Alternates: The specification is based on Parallam Plus PSL. No alternatives, modifications or substitutions are allowed unless the General Contractor and Sub-Contractors submits in writing for such requests to the Project Engineer for approval, no later than two weeks prior to bid. Alternate products must have design properties equivalent or greater than specified products. Substantiating calculations shall be submitted. All holes, tapered cuts and notching shall be justified for alternate. Contract shall reflect any price changes. The engineer of record shall be reimbursed for any review time.
  7. Preservative-treated wood shall conform to the requirements of the applicable AWPA Standard U1, as adopted per the project's building code.
  8. Preservative-treated beams and headers shall be treated to meet AWPA Use Category UC4A. Preservative-treated columns shall be treated to meet AWPA Use Category UC4B.
  9. Parallam Plus PSL or alternates shall have a minimum 30 year limited warranty against manufacture's defects and termite or fungal decay.
  10. Parallam Plus PSL can be drilled (as approved by the project engineer) or end cut to length without the need to field treat holes or end cuts. Do not rip/resize to custom depths along length of beam. Approved alternative preservative-treated beams shall have surface treatment field applied in accordance with AWPA Standard M4.
  11. Metal hardware or finishes in contact with treated lumber shall conform to manufactures' recommendations.
  12. For Trus Joist Product availability, contact TERRITORY MANAGER NAME & PHONE # or call 1-888-453-8358.

## 2.4 MISCELLANEOUS LUMBER

- A. Miscellaneous Dimension Lumber: Standard, Stud, or No. 2 grade with nineteen percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

## 2.5 MISCELLANEOUS PRODUCTS



- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with ASTM A 153/A 153M.
  - 1. Power-Driven Fasteners: CABO NER-272.
  - 2. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Structural capacity, type, and size indicated.
  - 1. Manufacturers:
    - a. Cleveland Steel Specialty Co.
    - b. KC Metals Products, Inc.
    - c. Phoenix Metal Products, Inc.
    - d. Simpson Strong-Tie Co., Inc.
    - e. USP Structural Connectors.
  - 2. Use anchors made from galvanized steel.
  - 3. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.
- C. Column Anchors
  - 1. Simpson 'Strong-Tie Anchor System'.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Securely attach rough carpentry to substrates, complying with the following:
  - 1. CABO NER-272 for power-driven fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. Table 2304.10.1 "Fastener Schedule" in the 2015 MI Building Code.
- E. Clean up all debris and leave all rough carpentry work in a condition acceptable to other trades.

END OF SECTION

## **TIMBERSTRAND® LSL SPECIFICATIONS**

### **1.0 GENERAL**

#### **1.1 Scope**

This work includes the complete furnishings and installation of all TimberStrand® laminated strand lumber (LSL) as shown on the drawings herein specified and necessary to complete the work.

#### **1.2 Code Approvals**

These products shall be designed and manufactured to the standards set forth in the ICC Evaluation Service, Inc. report ESR-1387.

#### **1.3 Related Work Specified Elsewhere**

**A Carpentry and Millwork**

**B Glu-Laminated Members**

#### **1.4 Design**

##### **A Products**

TimberStrand® LSL shall be designed to fit the dimensions and loads indicated on the plans.

##### **B Design Calculations**

\_\_\_ Member calculations shall be prepared by Weyerhaeuser. (Service Fees may apply)

\_\_\_ Not required.

#### **1.5 Submittals**

##### **A Drawings**

\_\_\_ Manufactures' product cut sheets.

##### **B Production**

Fabrication and/or cutting shall not proceed until the architect and/or engineer have approved the submittal package.

### **2.0 PRODUCTS**

#### **2.1 Materials**

##### **A Code Reports**

Materials shall comply with ICC ES ESR-1387.

##### **B Adhesives**

Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.

#### **2.2 Fabrication**

TimberStrand® LSL shall be manufactured by Weyerhaeuser in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured from strands of wood fiber in a continuous process with all strands oriented to the length of the member and then fed into a press. All members are to be free of finger or scarf joints or mechanical connections in full-length members.

## 2.3 Tolerances (dry material)

Tolerances for TimberStrand® LSL are product and application specific.

### A Standard Tolerances

|                                 |   |
|---------------------------------|---|
| Finished length (as specified): | ± 1/8"  |
| Depth:                          | + 1/16", - 0" (Rim Board)<br>± 1/16" (all other products) |
| Width:                          | ± 1/8"  |

### B Millwork and Furniture Frame Tolerances

Tolerances will vary based on manufacturer's requirements.

## 2.4 Identification

TimberStrand® LSL shall be identified by a stamp indicating the product type and grade and ICC ES evaluation report number, manufacturer's name, plant number and the independent inspection agency's logo.

TimberStrand® LSL for use in millwork or furniture frames shall be identified on the product wrapping.

## 2.5 Hardware

Not applicable.

# 3.0 EXECUTION

## 3.1 Installation

TimberStrand® LSL, if stored prior to installation, shall be protected from the weather. It shall be installed in accordance with the plans and any Weyerhaeuser drawings and installation suggestions. Temporary construction loads that cause stresses beyond design limits are not permitted. Safety bracing is to be provided by the installer to keep the TimberStrand® LSL straight and plumb as required and to assure adequate lateral support for the individual TimberStrand® LSL members and the entire system until the sheathing material has been applied.

The contractor may give notification to the manufacturer prior to installation of Trus Joist products to review and discuss product installation guidelines.

## 3.2 Performance Standards

Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5456.

## 3.3 Fire Rating

TimberStrand® LSL is permitted to be used in fire-resistive assemblies as a substitute for conventional wood framing. TimberStrand® LSL shall be sized for the same load-carrying capacity as the sawn lumber specified in the assembly, and its dimensions shall be equal to or greater than those specified for the sawn lumber. 1.25" minimum thickness TimberStrand® LSL may also be used in lieu of 2x nominal sawn lumber for fire blocking.

## 3.4 Warranty

The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building.

# 4.0 ALTERNATES AND/OR EQUALS

## 4.1 Modifications/Alternates:

Due to the customized detailing and engineering characteristics of the roof, wall and/or floor framing assembly, it is a requirement that TimberStrand LSL be used in the base bid.

The specification is based on Trus Joist engineered wood products. No alternatives, modifications or substitutions are allowed unless the General Contractor and Sub-Contractors submits in writing for such requests to the Project Engineer for approval, no later than two weeks prior to bid. Alternate products must have a current ICC-ES code evaluation report with listed design properties equivalent or greater than specified products. Substantiating calculations shall be submitted. All floor performance, fire endurance, holes, tapered cuts and notching shall be justified for alternate. Contract shall reflect any price changes. The engineer of record shall be reimbursed for any review time.

## SECTION 06 16 00 - SHEATHING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Roof sheathing.
  - 2. Ceiling panels.

#### 1.02 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.01 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing and flashing.

#### 2.02 PLYWOOD ROOF SHEATHING AND CEILING PANELS

- A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2; APA Rated Sheathing; Exposure 1.
  - 1. Performance Category: As needed to comply with requirements specified, but not less than nominal thickness indicated.
  - 2. Span Rating: To suit framing spacing.
  - 3. Factory mark plywood panels to indicate compliance with applicable standard.

#### 2.03 OSB ROOF SHEATHING

- A. OSB Sheathing: DOC PS 2; APA Rated Sheathing; Exposure 1.
  - 1. Performance Category: As needed to comply with requirements specified, but not less than nominal thickness indicated.
  - 2. Span Rating: To suit framing spacing.
  - 3. Factory mark OSB panels to indicate compliance with applicable standard.

#### 2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

## 2.05 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.10.1, "Fastening Schedule," in ICC's "Michigan Building Code."
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Cut and space edges of panels to match spacing of structural support elements.

### 3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
  - 1. Apply panels with face grain perpendicular to framing and with ends bearing on framing members.
  - 2. Space panels 1/8 inch apart at edges and ends.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Sheathing to Wood Framing: Nail or staple sheathing to framing. Apply a continuous bead of adhesive to framing members at edges of wall sheathing panels.

END OF SECTION 06 16 00

## SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Wood roof trusses.
  - 2. Wood truss bracing.
  - 3. Metal truss accessories.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
- B. Shop Drawings: Show fabrication and installation details for trusses.
  - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
  - 2. Indicate sizes, stress grades, and species of lumber.
  - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
  - 6. Show splice details and bearing details.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Evaluation Reports: For the following, from ICC-ES:
  - 1. Metal-plate connectors.
  - 2. Metal truss accessories.

#### 1.04 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
  - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an

independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE / DESIGN CRITERIA

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

#### 2.02 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

#### 2.03 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpine Engineered Products, Inc.; an ITW company.
  - 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
  - 3. CompuTrus, Inc.
  - 4. Eagle Metal Products.
  - 5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
  - 6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
  - 7. Robbins Engineering, Inc.
  - 8. Truswal Systems Corporation; an ITW company.
  - 9. Comparable products by other manufacturers will be considered.
- B. General: Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

## 2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F 1667.

## 2.05 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cleveland Steel Specialty Co.
  - 2. KC Metals Products, Inc.
  - 3. Phoenix Metal Products, Inc.
  - 4. Simpson Strong-Tie Co., Inc.
  - 5. USP Structural Connectors.
  - 6. Comparable products by other manufacturers will be considered.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

## 2.06 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
  - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- C. Install and brace trusses according to TPI recommendations and as indicated.



- D. Anchor trusses securely at bearing points; use metal truss tie-downs. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- E. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing as required.
- F. Install wood trusses within installation tolerances in TPI 1.
- G. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- H. Replace wood trusses that are damaged or do not meet requirements.

END OF SECTION 06 17 53

## SECTION 07 31 13 ASPHALT SHINGLES

### PART 1 - GENERAL

#### 1.1 GENERAL 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. Asphalt shingles.
  - 2. Underlayment.
  - 3. Metal flashing and trim.
- B. Related Requirements:
  - 1. None.

#### 1.3 DEFINITION

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Not required.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- A. Samples: For each exposed product and for each color and texture specified.
  - 1. Asphalt Shingles: Full size.
- B. Samples for Initial Selection: For each type of asphalt shingle indicated.
  - 1. Include similar Samples of accessories involving color selection.
- C. Samples for Verification: For the following products, of sizes indicated:
  - 1. Asphalt Shingles: Full size.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Evaluation Reports: For synthetic underlayment, from ICC-ES or other testing and inspecting agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.
- D. Sample Warranty: For manufacturer's warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For asphalt shingles to include in maintenance manuals.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Asphalt Shingles: 50 sq. ft. of each type, in unbroken bundles.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.
- B. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.
- E. Handle, store and place roofing materials on the roof prior to application in a manner so as to prevent deformation and/or damage to the shingle bundles or shingles.

#### 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.

## 1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
  - 2. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first three years nonprorated.
  - 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for five years from date of Substantial Completion.
  - 4. Workmanship Warranty Period: One years from date of Substantial Completion.
- B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt-shingle roofing that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

## 2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Three-Tab-Strip Asphalt Shingles: ASTM D 3462/D 3462M, glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; Landmark Premium Series listed on the following link; <http://www.certainteed.com/Pros/Technical-Information> or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
    - c. Other Approved Manufacturer.
  - 2. Strip Size: Manufacturer's standard.
  - 3. Color: To Match Existing

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, asphalt-saturated organic felts, nonperforated.
  - 1. Type: Type I.
- B. Glass-Reinforced Felt: ASTM D 6757, glass-reinforced, asphalt-saturated organic felt.

1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; Roofers Select High-Performance Underlayment or comparable product by one of the following:
  - a. GAF Materials Corporation.
  - b. Owens Corning.
- C. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; DiamondDeck Synthetic High-Performance Underlayment or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
- D. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D 1970/D 1970M, minimum of 50-mil- (1.3-mm-) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; WinterGuard or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
- E. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970/D 1970M, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release backing; cold applied.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; WinterGuard or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.

## 2.4 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.
  1. Shank: Smooth.
  2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.
- D. Synthetic-Underlayment Fasteners Metal or Disc Cap: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

## 2.5 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Anodized aluminum or Aluminum, mill finished.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
- C.
  - 1. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge. Match existing profile.
- D. Vent Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

## 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.
  - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provisions have been made for flashings and penetrations through asphalt shingles.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt-underlayment or roofing nails.
  - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction that sheds water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.
  - 2. Install fasteners at no more than 36 inches o.c.

3. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches in direction that sheds water.
  4. Terminate felt underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.
  5. Install fasteners at no more than 36 inch o.c.
- C. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.
1. Install in single layer on roofs sloped at 4:12 and greater.
  2. Install in double layer on roofs sloped at less than 4:12.
- D. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

### 3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Rake Drip Edges: Install rake drip-edge flashings over underlayment and fasten to roof deck.
- C. Eave Drip Edges: Install eave drip-edge flashings below underlayment and fasten to roof sheathing.
- D. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

### 3.4 ASPHALT-SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip with tabs removed or at least 7 inches wide with self-sealing strip face up at roof edge.
1. Extend asphalt shingles (dimension to match existing) over fasciae at eaves and rakes.
  2. Install starter strip along rake edge.

- A. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern or as specified by the roofing Manufacturer at succeeding courses, maintaining uniform exposure.
- B. Fasten asphalt-shingle strips with a minimum of roofing nails located according to manufacturer's written instructions.

### 3.5 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:
  - 1. Owner: <Insert name of Owner>.
  - 2. Address: <Insert address>.
  - 3. Building Name/Type: <Insert information>.
  - 4. Address: <Insert address>.
  - 5. Area of the Work: <Insert information>.
  - 6. Acceptance Date: <Insert date>.
  - 7. Warranty Period: <Insert time>.
  - 8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding 120 mph;
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  - 2. When the work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  - 3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.



4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty shall not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.
5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty shall become null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.

1. Authorized Signature: **<Insert signature>**.
2. Name: **<Insert name>**.
3. Title: **<Insert title>**.

END OF SECTION 073113

## SECTION 07 46 00 VINYL SIDING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Solid vinyl siding.
- B. Solid vinyl soffit.
- C. Vinyl trim.

#### 1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry

#### 1.3 REFERENCES

- A. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
- B. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.
- E. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C. and 30 Degrees C.
- F. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- G. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
- H. ASTM D 3679 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding.
- I. ASTM D 4477 - Standard Specification for Rigid Unplasticized Poly(Vinyl Chloride) (PVC) Soffit.
- J. ASTM D 6864 - Standard Specification for Color and Appearance Retention of Solid Colored Plastic Siding Products.
- K. ASTM D7251 - Standard Specification for Color and Appearance Retention of Variegated Color Plastic Siding Products
- L. ASTM D 7856 - Standard Specification for Color and Appearance Retention of Solid and Variegated Color Plastic Siding Products using CIELab Color Space.
- M. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

- N. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000.
- O. UBC STD 26-9 - Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus; 1997.

#### 1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Code compliance in accordance with the following:
  - 1. Metropolitan Dade County, Florida.
  - 2. ICC Evaluation Service.
  - 3. State of Florida.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance and care requirements.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installer with not less than three years of experience with products specified.
- B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.
  - 4. Accepted mock-ups shall be comparison standard for remaining work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store on a flat surface under cover, stacked no more than 12 boxes high. Do not store in location where temperatures may exceed 130 degrees F.

#### 1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute

limits.

## 1.9 WARRANTY

- A. Provide manufacturer's standard limited lifetime warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Ply Gem Industries, Inc., 2600 Grand Blvd., Suite 900, Kansas City, MO 64108. ASD. Telephone Toll Free: (800) 962-6973 or (800) 788-1964. Fax: (866) 656-1900, Website: [www.gpvynilsiding.com](http://www.gpvynilsiding.com). Email: [support@mastichomesinfo.com](mailto:support@mastichomesinfo.com).
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### 2.2 MATERIALS

- A. Siding and Soffit - General Requirements: Polyvinyl chloride products with the following characteristics:
  - 1. Siding: Comply with ASTM D 3679, Class 2.
  - 2. PVC cell classification in accordance with ASTM D 1784: 13334.
  - 3. Coefficient of linear expansion in accordance with ASTM D 696: 0.000029 inch per inch per degree F.
  - 4. Tensile strength when tested in accordance with ASTM D 638: Minimum 6,326 pounds per square inch.
  - 5. Modulus of elasticity when tested in accordance with ASTM D 638: Minimum 360,000 pounds per square inch, average.
  - 6. Izod impact, standard 1/8 inch bar when tested in accordance with ASTM D 256: 3.30 foot-pounds per inch, average.
  - 7. Shore D Hardness: Minimum 82.
  - 8. Specific Gravity: Minimum 1.39.
  - 9. Deflection temperature when tested in accordance with ASTM D 648: 170 degrees F, 264 pounds per square inch.
  - 10. Smoke density rating when tested in accordance with ASTM D 2843: 48 percent, average.
  - 11. Horizontal flammability, when tested in accordance with ASTM D 635:
    - a. Burn distance: 20 mm.
    - b. Burn time: Less than 5 seconds.
  - 12. Surface burning characteristics when tested in accordance with ASTM E 84: Flame spread less than 20, fuel contribution 0, smoke density 275.
  - 13. Fire Resistance - Siding: 1 hour, when tested in accordance with ASTM E 119, with siding applied over gypsum sheathing.
  - 14. Flammability - Siding: Comply with requirements of UBC Std 26-9.
  - 15. Caliber Double 6 inch, foamed backed siding with EPS foam backing has a Permeability Rating of 5.
- B. Fasteners: Aluminum nails, alloy 5056 or 6110, having minimum tensile strength 63,000 pounds per square inch.
- C. Vapor Retarder: Specified in Section 07 26 00.

- D. Joint Sealers: Specified in Section 07 90 00.

## 2.3 VINYL SIDING AND TRIM

- A. Mastic Eclipse Vinyl Siding:
  - 1. Product Description: Double 4 Traditional
    - a. Color: As selected from manufacturer's full range of standard colors.
    - b. VSI Certified Insulated siding with Color Retention: Meets or exceeds requirements of ASTM D 7856, ASTM D 6864, and ASTM D 7251.

## 2.4 VINYL SOFFIT AND TRIM

- A. Vinyl T/4 Soffit: Use with 1/2 inch installation accessories.
  - 1. Product Description: Triple 4 inch Solid Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length.
  - 2. Product Description: Triple 4 inch Full-Vent Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length. Basketweave Venting, with Net Free Air Space of 14.34 sq. inches / square foot.
  - 3. Product Description: Triple 4 inch Center Vent Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length. Basketweave Venting, with Net Free Air Space of 4.78 sq. inches / square foot.
  - 4. Nailing Hem: Single-row, with elongated nailing holes 1-1/4 inches long at 1- 5/8 inches on center.
  - 5. Color: As selected from manufacturer's full range of standard colors.
  - 6. VSI Certified Vinyl siding with Color Retention: Meets or exceeds requirements of ASTM D 7856, ASTM D 6864, and ASTM D 7251.
- B. Vinyl Trim:
  - 1. Soffit J-Trim 1/2 inch: Channel, 1-1/2 inches nailing leg, 3/4 inch forward leg, 1/2 inch channel width; \_\_\_\_\_color. Length 12 foot 6 inches.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. Verify dimensions and acceptability of substrate
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Installation of vapor retarder is specified in Section 07 26 00
- C. Attach vinyl products to substrate for weathertight installation; ensure that horizontal components are installed true to level, that vertical components are installed true to plumb.
- D. Stagger lap joints in horizontal siding in uniform pattern as successive courses of siding are installed.
- E. Install joint sealers as specified in Section 07900.

### 3.4 ADJUSTING AND CLEANING

- A. Clean dirt from surface of installed products, using mild soap and water.
- B. After completing installation, remove from project site excess materials and debris resulting from installation of vinyl products.

### 3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes hollow-metal work.

#### 1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.
  - 4. Karpen Steel Custom Doors & Frames.
  - 5. Mesker Door Inc.
  - 6. Republic Doors and Frames.
  - 7. Steelcraft; an Ingersoll-Rand company.

#### 2.02 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3..
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Polyurethane.
  - 3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
  - 4. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.

- b. Construction: Full profile welded.
- 5. Exposed Finish: Prime.

## 2.03 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.04 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- F. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

## 2.05 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.



2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  3. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Three anchors per jamb from 60 to 90 inches high.
  4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
    - a. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.06 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: SDI A250.10.

## 2.07 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Install door silencers in frames before grouting.
    - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
    - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

### 3.02 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 08 11 13

## SECTION 08 36 00 SECTIONAL OVERHEAD DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Insulated Sectional Overhead Doors.
- B. Electric Operators and Controls.
- C. Operating Hardware, tracks, and support.

#### 1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 22 00 - Concrete Masonry Unit.
- C. Section 05 50 00 - Metal Fabrications.
- D. Section 06 10 00 – Rough Carpentry.

#### 1.3 REFERENCES

- A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

#### 1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.

- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.

## 1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

## 1.9 WARRANTY

- A. Warranty: Manufacturer's limited door and operators System warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.
- B. Warranty: Manufacturer's limited door and operators System warranty for 8 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.
- C. Warranty: Manufacturer's limited door and operators System warranty for 10 years against delamination of polystyrene foam from steel face.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corporation, which is located at: 2501 S. State Hwy. 121 Suite 200; Lewisville, TX 75067; Toll Free Tel: 800-275-3290; Tel: 469-549-7100; Fax: 972-906-1499; Email: [request info \(info@overheaddoor.com\)](mailto:info@overheaddoor.com); Web: <https://www.overheaddoor.com>
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### 2.2 INSULATED SECTIONAL OVERHEAD DOORS

- A. Insulated Steel Sectional Overhead Doors: 470 Series Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
  - 1. Door Assembly: Rigid steel construction; fully insulated on the inside face with continuous steel backing on the inside face. Fabricated with steel end stiles and tongue and groove sections.
    - a. Panel Thickness: 2 inches (51 mm).
    - b. Exterior Surface: Ribbed.
    - c. Exterior Steel: 26 gauge, hot-dipped galvanized with an embossed simulated wood grain texture.
    - d. Interior Steel: 29 gauge, hot-dipped galvanized
    - e. Springs:
      - 1) 10,000 cycles.

- 2) 25,000 cycles.
    - 3) 50,000 cycles.
    - 4) 75,000 cycles.
    - 5) 100,000 cycles.
  - f. Insulation: Polystyrene.
  - g. Thermal Values:
    - 1) Polystyrene - R-value of 9.83; U-value of 0.102.
  - h. Partial Glazing of Steel Panels:
    - 1) 19 inch by 12 inch window.
      - a) DSB
      - b) Tempered Glass
      - c) Clear Lexan
      - d) Solar Bronze
      - e) Obscure
    - 2) 42 inch by 13 inch window.
      - a) DSB
- 2. Finish and Color: Two coat baked-on polyester. Color as follows:
  - a. White
- 3. Windload Design: Provide to meet the Design/Performance requirements specified.
- 4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
- 5. Lock:
  - a. Interior mounted slide lock.
- 6. Weatherstripping:
  - a. Flexible bulb-type strip at bottom section.
  - b. Flexible Jamb seals.
  - c. Flexible Header seal.
- 7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
- 8. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
  - a. Entrapment Protection: Required for momentary contact, includes radio control operation.
    - 1) Pneumatic sensing edge up to 18 feet (5.5 m) wide. Constant contact only complying with UL 325/2010.
    - 2) Electric sensing edge monitored to meet UL 325/2010.
    - 3) Photoelectric sensors monitored to meet UL 325/2010.
  - b. Operator Controls:
    - 1) Push-button operated control stations with open, close, and stop buttons.
    - 2) Surface mounting.
    - 3) Interior location.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until openings have been properly prepared.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.

- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean adjacent surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- C. Anchor assembly to wall construction and building framing without distortion or stress.
- D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- E. Fit and align door assembly including hardware.
- F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

### 3.4 CLEANING AND ADJUSTING

- A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
- B. Clean doors, frames, glass and polycarbonate according to manufacturer's instructions.
- C. Remove temporary labels and visible markings. Do not remove polycarbonate care and maintenance label required to maintain warranty.

### 3.5 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.
- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes:
  - 1. Mechanical door hardware for swinging doors.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type and finish of exposed hardware for verification.
  - 1. Tag Samples with full description for coordination with the door hardware schedule.
  - 2. Submit Samples before or concurrent with submission of door hardware schedule.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE CRITERIA

- A. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### 2.02 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated and complying with BHMA designations referenced. Provide named products or products of other manufacturers equivalent in function and comparable in quality to named products.
    - a. Designations: Requirements for quantity, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article.

- b. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.
- c. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

## 2.03 HINGES

- A. Hinges: BHMA A156.1.
  - 1. Manufacturers:
    - a. Baldwin Hardware Corporation.
    - b. Bommer Industries, Inc.
    - c. Cal-Royal Products, Inc.
    - d. Hager Companies.
    - e. IVES Hardware; an Ingersoll-Rand company.
    - f. Lawrence Hardware Inc.
    - g. McKinney Products Company; an ASSA ABLOY Group company.
    - h. PBB, Inc.
    - i. Stanley Commercial Hardware; Div. of The Stanley Works.
    - j. Comparable products by other manufacturers will be considered.

## 2.04 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- D. Lock Trim:
  - 1. Description: As scheduled.
  - 2. Levers: Wrought.
  - 3. Escutcheons (Roses): Wrought.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.
  - 1. Manufacturers:
    - a. Arrow USA; an ASSA ABLOY Group company.
    - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - c. Cal-Royal Products, Inc.
    - d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
    - e. Falcon Lock; An Ingersoll-Rand Company.
    - f. K2 Commercial Hardware; a Black & Decker Corp. company.
    - g. Marks USA.
    - h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.



- i. PDQ Manufacturing.
- j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- l. Weiser Lock Corp.; a Black & Decker Corp. company.
- m. Yale Security Inc.; an ASSA ABLOY Group company.
- n. Comparable products by other manufacturers will be considered.

## 2.05 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver or brass.

## 2.06 ACCESSORIES FOR PAIRS OF DOORS

- A. None

## 2.07 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
  - 1. Manufacturers:
    - a. Architectural Builders Hardware Mfg., Inc.
    - b. Glynn-Johnson; an Ingersoll-Rand company.
    - c. Rockwood Manufacturing Company.
    - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - e. Comparable products by other manufacturers will be considered.

## 2.08 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
  - 1. Manufacturers:
    - a. Hager Companies.
    - b. M-D Building Products, Inc.
    - c. National Guard Products.
    - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
    - e. Reese Enterprises, Inc.
    - f. Sealeze; a unit of Jason Incorporated.
    - g. Zero International.
    - h. Comparable products by other manufacturers will be considered.

## 2.09 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
  - 1. Manufacturers:
    - a. Hager Companies.

- b. M-D Building Products, Inc.
- c. National Guard Products.
- d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
- e. Reese Enterprises, Inc.
- f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
- g. Sealeze; a unit of Jason Incorporated.
- h. Zero International.
- i. Comparable products by other manufacturers will be considered.

## 2.10 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except as approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

## 2.11 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Generally, Satin Chrome, US26D:
  - 1. Aluminum Thresholds: Mill Finish.
- E. Aluminum Astragals, Stop Seals, Automatic Door Bottoms, Bottom Seals, and Weather-stripping: Satin Aluminum, Clear Anodized, US28.

## PART 3 - EXECUTION

### 3.01 EXAMINATION AND PREPARATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.
- B. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Field Door Preparation to Receive Hardware:
  - 1. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

### 3.02 INSTALLATION

- A. Comply with manufacturer's written installation instructions and recommendations and approved submittals.
  - 1. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing.
  - 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: Per DHI "Recommended Locations for Architectural Hardware for Standard Steel Doors & Frames."
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Thresholds: Set thresholds for exterior doors in full bed of butyl sealant.
- E. Gasketing: Apply to head and jamb perimeter, forming seal between door and frame.

### 3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.

- B. Clean operating items as necessary to restore proper function and finish.

3.05 PROTECTION

- A. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06 SCHEDULE

- A. See construction drawings sheet A-3

END OF SECTION 08 71 00

## SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.
11. Mechanical Identification
12. Pipe curbs and equipment supports.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Operation and Maintenance Data: At the end of the project the contractor shall submit two paper copies of the Operation and Maintenance Data to the owner in three ring binders with the project title and contractor's contact information.

D. Project Record Documents: Throughout the project the contractor shall keep a running record of as-builts showing deviations from the plans. At the end of the project the contractor shall submit one clean hand sketch set of documents to the owner.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Drawings are diagrammatical and do not necessarily show all fittings required to meet field conditions and coordination requirements with other trades. The contractor is responsible for making adjustments in the routing and elevations to meet the job requirements and maintaining required slopes as required for each system.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
  2. CPVC Piping: ASTM F 493.
  3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  4. Aboveground Pressure Piping: Pipe fitting.



- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.

- f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150 or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:

- a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Metraflex Co.
  - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
  4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.

1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated or rough-brass finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

- b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
  - P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
    - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
    - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
    - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  - Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
  - R. Verify final equipment locations for roughing-in.
  - S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
  - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
  - E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Install equipment per the manufacturer's recommendations. If the manufacturer's recommendations are different than shown on the construction documents or as otherwise specified contact the engineer.
- F. Contractor shall provide all equipment and associated controls required to provide a complete and operable system.

- G. The scope of work for all Division 22 sections includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.

### 3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Architectural Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500



## SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following general-duty valves:
  - 1. Copper-alloy ball valves.
  - 2. Gate valves.
- B. See other Sections for general-duty and specialty valves for site construction piping.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

#### 1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 and 372 for valve materials for potable-water service.
- D. ANSI Compliance: ANSI 372
- E. Senate Bills 3874: All valves 2 inches and smaller shall be lead free with lead content less than 0.25%.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Brass Valves: NPS 2 and Smaller: Victaulic VIP Press 304™ ends, unless otherwise indicated
- D. Ferrous Valves NPS 2-1/2 and Larger: Grooved or flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
  - 1. Handwheel: For valves other than quarter-turn types.
  - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: ASME/AWWA C606.
  - 1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for check, gate, and globe valves; below 421 deg F for ball valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
- K. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
  - 1. One-Piece, Copper-Alloy Ball Valves:
    - a. Conbraco Industries, Inc.; Apollo Div.
    - b. Jenkins Valves.
    - c. Stockham Valves.
    - d. Grinnell Corporation.
    - e. Jamesbury, Inc.
    - f. NIBCO INC.
    - g. Watts Industries, Inc.; Water Products Div.
  - 2. Two-Piece, Copper-Alloy Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Div.
- b. Crane Valves.
- c. Jenkins Valves.
- d. Stockham Valves.
- e. Grinnell Corporation.
- f. Hammond Valve.
- g. Jamesbury, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Victaulic Company of America
- k. Watts Industries, Inc.; Water Products Div.

B. Plumbing

1. Ball Valves – 2” and Smaller (Alternate to standard port): Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, full port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.
2. Ball Valves – 3” and Smaller: Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, STD port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.

2.4 GATE VALVES

A. Manufacturers:

1. Gate Valves:
  - a. Cincinnati Valve Co.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Grinnell Corporation.
  - f. Hammond Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell, Wm. Co.
  - j. Watts Industries, Inc.; Water Products Div.

B. Plumbing

1. Gate Valves – Up To 2 ½”: Gate valves shall be class 125# SWP, 200# WOG, rising stem, threaded bonnet, solid wedge, malleable iron handwheel, body and bonnet shall be of ASTM B62 bronze, non-asbestos packing, MSS SP-80.
2. Gate Valves – 3” and larger: Gate valves shall be class 125# SWP, 200# WOG, rising stem, OS&Y, bolted bonnet, body and bonnet shall be of ASTM A126 Class B cast iron, flange ends, bronze trim, non-asbestos packing, MSS SP-70.

## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, or gate valves.
  - 2. Throttling Service: Ball, butterfly, or globe valves.
  - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

### 3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Provide stem extensions for ball valves being installed on insulated lines.
- G. Provide memory stops for all valves to be used for balancing.
- H. Install butterfly valves with stem at the horizontal, and so that the handle points down when closed, and in the direction of flow when in the open position.
- I. Adjust all packing nuts after installation.
- J. Provide lever handles for 6" and smaller butterfly valves.
- K. Provide gear operator for 8" and larger butterfly valves.
- L. Provide chain wheel operator when above 7 feet.

### 3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

## SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. See Division 22 Section "Mechanical Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation supports and hangers and seismic restraints.

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 MANUFACTURED UNITS

### A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components.

#### 1. Manufacturers:

- a. AAA Technology and Specialties Co., Inc.
- b. B-Line Systems, Inc.
- c. Carpenter & Patterson, Inc.
- d. Empire Tool & Manufacturing Co., Inc.
- e. Globe Pipe Hanger Products, Inc.
- f. Anvil International.
- g. GS Metals Corp.
- h. Michigan Hanger Co., Inc.
- i. National Pipe Hanger Corp.
- j. PHD Manufacturing, Inc.
- k. PHS Industries, Inc.
- l. Piping Technology & Products, Inc.

2. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

### B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

#### 1. Manufacturers:

- a. B-Line Systems, Inc.
- b. Anvil International.
- c. GS Metals Corp.
- d. Michigan Hanger Co., Inc.
- e. National Pipe Hanger Corp.
- f. Thomas & Betts Corp.
- g. Unistrut Corp.
- h. Wesanco, Inc.

2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

### C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.

#### 1. Manufacturers:

- a. Carpenter & Patterson, Inc.
- b. Michigan Hanger Co., Inc.
- c. PHS Industries, Inc.
- d. Pipe Shields, Inc.
- e. Rilco Manufacturing Co., Inc.

## f. Value Engineered Products, Inc.

2. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
3. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Hanger Rods: Galvanized all-thread, ASTM A 36.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

## 3.1 APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 120 to 450 deg F pipes, NPS 4 to NPS 16 , 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 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  5. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.



6. 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.
  7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  8. 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.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. 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.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

### 3.2 INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- 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. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- J. Insulated Piping: Comply with the following:
  - 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 according to ASME B31.9.
  - 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.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
  - 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 inserts.
  - 6. Insert Material: Length at least as long as protective shield.
  - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor. Place grout under supports for equipment and make smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching Up: 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

## SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Pipe markers.
5. Stencils.
6. Valve tags.
7. Warning tags.

#### 1.3 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### 1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
  - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  - 3. Thickness: 1/8 inch, unless otherwise indicated.
  - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length

3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, and 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.

## 2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs and similar operational instructions.
1. Stencil Material: Metal or fiberboard
  2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch-thick brass or aluminum.
  2. Material: 3/32-inch-thick laminated plastic with 2 black surfaces and white inner layer.
  3. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

## 2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 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. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Pumps, compressors and similar motor-driven units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
  - 1. Letter Size: Minimum 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.
  - 2. Data: Distinguish among multiple units,
  - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Pumps, compressors and similar motor-driven units.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.



- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
  - 1. Identify mechanical equipment with equipment markers in the following color codes:
    - a. **[Yellow]**: For heating equipment and components.
  - 2. Letter Size: Minimum 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.
  - 3. Data: Distinguish among multiple units, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Include signs for the following general categories of equipment:
  - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  - 2. Pumps, compressors and similar motor-driven units.
- F. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- G. Install access panel markers with screws on equipment access panels.

### 3.3 PIPING IDENTIFICATION

- A. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; 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.

### 3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Provide warning tags on equipment and with wording as directed by the Architect.

### 3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### 3.8 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 220553

## SECTION 230500 – COMMON WORK RESULTS FOR HVAC

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Transition fittings.
  - 2. Mechanical sleeve seals.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Grout.
  - 6. Equipment installation requirements common to equipment sections.
  - 7. Painting and finishing.
  - 8. Supports and anchorages.
  - 9. Mechanical Identification

## 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

C. Operation and Maintenance Data: At the end of the project the contractor shall submit two paper copies of the Operation and Maintenance Data to the owner in three ring binders with the project title and contractor's contact information.

D. Project Record Documents: Throughout the project the contractor shall keep a running record of as-builts showing deviations from the plans. At the end of the project the contractor shall submit one clean hand sketch set of documents to the owner.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Install all equipment, materials, and accessories per manufacturers written instructions.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8-inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.7 MECHANICAL IDENTIFICATION

- A. Duct Labels:
  - 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: Black

3. Background Color: White
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-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
10. 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.

B. Stencils:

1. Stencils for Ducts:
  - a. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  - b. Stencil Material: Aluminum
  - c. Stencil Paint: Exterior, gloss, alkyd enamel Paint may be in pressurized spray-can form.
  - d. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Install equipment per the manufacturer's recommendations. If the manufacturer's recommendations are different than shown on the construction documents or as otherwise specified contact the engineer.



- F. Contractor shall provide all equipment and associated controls required to provide a complete and operable system.
- G. The scope of work for all Division 23 sections includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.

### 3.2 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Architectural Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.5 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

### 3.6 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.7 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For outside air ducts.
  - 2. Orange: For exhaust ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.8 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.

### 3.9 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230500

## SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. See Division 21 Sections on fire-suppression piping for fire-suppression piping hangers and supports.
- C. See Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation supports and hangers and seismic restraints.

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 MANUFACTURED UNITS

- A. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Manufacturers:
  - a. B-Line Systems, Inc.
  - b. Grinnell Corp.
  - c. GS Metals Corp.
  - d. Michigan Hanger Co., Inc.
  - e. National Pipe Hanger Corp.
  - f. Thomas & Betts Corp.
  - g. Unistrut Corp.
  - h. Wesanco, Inc.
2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

## 2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Hanger Rods: Galvanized all-thread, ASTM A 36.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

- C. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
- D. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. 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.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- E. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- F. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

### 3.2 INSTALLATION

- A. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- B. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- D. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor. Place grout under supports for equipment and make smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching Up: 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

## 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 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Equipment markers.
  - 3. Equipment signs.
  - 4. Duct markers.
  - 5. Stencils.
  - 6. Warning tags.

#### 1.3 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### 1.5 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 location of access panels and doors.



- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
  - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  - 3. Thickness: 1/8 inch, unless otherwise indicated.
  - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### 2.2 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

## 2.3 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 markers, equipment markers, equipment signs, and similar operational instructions.
  - 1. Stencil Material: Metal or fiberboard.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 WARNING TAGS

- A. Warning Tags: 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. Color: Yellow background with black lettering.

# PART 3 - EXECUTION

## 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

## 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
  - 2. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  - 3. Fans, blowers and air terminals.
  - 4. Air handling units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 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.
  2. Data: Distinguish among multiple units,
  3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fire department hose valves and hose stations.
    - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - e. Air handling units, air terminals, and fan coil units.
    - f. Tanks and pressure vessels.
    - g. Humidifiers, water-treatment systems, and similar equipment.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
    - a. Green: For cooling equipment and components.
    - b. Yellow: For heating equipment and components.
    - c. Orange: For combination cooling and heating equipment and components.
    - d. Brown: For energy-reclamation equipment and components.
  2. Letter Size: Minimum 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.
  3. Data: Distinguish among multiple units, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Include signs for the following general categories of equipment:
1. Fans, blowers and air terminals.
- F. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- G. Install access panel markers with screws on equipment access panels.

### 3.3 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
  - 1. Green: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
  - 5. Letter Size: Minimum 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.
- B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate markers 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.

### 3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Provide warning tags on equipment and with wording as directed by the Architect.

### 3.5 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### 3.6 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

## SECTION 230700 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
  - c. Polyisocyanurate.
  - d. Polystyrene.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

- B. Related Sections include the following:

- 1. Division 23 Section "Metal Ducts" for duct liners.

#### 1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVDC: Polyvinylidene chloride.

- E. SSL: Self-sealing lap.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Show details for the following:
  - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Field application for each equipment type.

#### 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. National Commercial and Industrial Insulation Standards: Comply with installation standards.
- D. ASHRAE Standard 90.1-2004: Comply with insulation values required by the Energy Standards.

#### 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.8 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 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Paint flexible Elastomeric insulation exposed to sun light with Armaflex WB finish, white.
  - 1. Products:

- a. Aeroflex USA Inc.; Aerocel.
  - b. Armacell LLC; AP Armaflex.
  - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
  1. Products:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- H. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
  1. Products:
    - a. Apache Products Company; ISO-25.
    - b. Dow Chemical Company (The); Trymer.
    - c. Duna USA Inc.; Corafoam.
    - d. Elliott Company; Elfoam.
  2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
  3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
  4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
  5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    - a. Pipe Applications: ASJ-SSL.
    - b. Equipment Applications: ASJ or ASJ-SSL.
- I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
  1. Products:
    - a. Dow Chemical Company (The); Styrofoam.
    - b. Knauf Insulation; Knauf Polystyrene.



## 2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  - 1. Products:
    - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products:
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

## 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- D. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

## 1. Products:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 97-13.

- 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:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- F. PVC Jacket Adhesive: Compatible with PVC jacket.

## 1. Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

## 2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

## 1. Products:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

- 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
- 3. Service Temperature Range: Minus 20 to plus 180 deg F.
- 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
- 5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:
  - a. Childers Products, Division of ITW; CP-30.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
  - c. ITW TACC, Division of Illinois Tool Works; CB-25.
  - d. Marathon Industries, Inc.; 501.
  - e. 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:
  - a. Childers Products, Division of ITW; Encacel.
  - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
  - c. Marathon Industries, Inc.; 570.
  - d. Mon-Eco Industries, Inc.; 55-70.
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:
  - a. Childers Products, Division of ITW; CP-10.
  - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
  - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
  - d. Marathon Industries, Inc.; 550.
  - e. Mon-Eco Industries, Inc.; 55-50.
  - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

## 2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products:

- a. Childers Products, Division of ITW; CP-52.
  - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
  - c. Marathon Industries, Inc.; 130.
  - d. Mon-Eco Industries, Inc.; 11-30.
  - e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  3. Service Temperature Range: Minus 50 to plus 180 deg F.
  4. Color: White.

## 2.7 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate Products:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products:
  - a. Childers Products, Division of ITW; CP-70.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
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.

### B. FSK and Metal Jacket Flashing Sealants:

1. Products:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products:

- a. Childers Products, Division of ITW; CP-76.
- b. Materials shall be compatible with insulation materials, jackets, and substrates.
- c. Fire- and water-resistant, flexible, elastomeric sealant.
- d. Service Temperature Range: Minus 40 to plus 250 deg F.
- e. Color: White.

## 2.8 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:

- a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
- b. Compac Corp.; 104 and 105.
- c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
- 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 and UL listed.

1. Products:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
- b. Compac Corp.; 110 and 111.
- c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
- d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/ inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. 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 and UL listed.
1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/ inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/ inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:
  - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/ inch in width.

## 2.10 SECUREMENTS

### A. Bands:

1. Products:
  - a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **[0.106-inch]** **[0.135-inch]** diameter shank, length to suit depth of insulation indicated.
  - a. Products:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **[0.106-inch-]** **[0.135-inch]** diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.

- 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) GEMCO; Nylon Hangers.
    - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
    - 4) Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.



- b. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  - 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-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:
      - 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.
  - 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Manufacturers:
      - 1) GEMCO.
      - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.
  - 1. Manufacturers:
    - a. ACS Industries, Inc.
    - b. C & F Wire.
    - c. Childers Products.
    - d. PABCO Metals Corporation.
    - e. RPR Products, Inc.

## 2.11 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 (ASTM B 209M), 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 **[304] [316] [304 or 316]**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation in strict accordance with the manufacturer's installation instructions and the National Commercial and Industrial Insulation Standards.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. 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.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **[2 inches] [4 inches]** o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

- P. 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.
- Q. 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 Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

### 3.5 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

### 3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3-inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.8 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 exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, above ground exposed supply and return.

#### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.

3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed supply ductwork outside of the mechanical room, in an occupied area being conditioned by the supply ductwork

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Exposed, round and flat-oval, outdoor-air duct insulation shall be any of the following:
  1. Flexible Elastomeric: 2-inches thick.
  2. Mineral-Fiber Board: 2-inches thick and 2-lb/cu. ft. nominal density.
- B. Exposed, round and flat-oval, exhaust-air duct insulation shall be any of the following:
  1. Flexible Elastomeric: 2-inches thick.
  2. Mineral-Fiber Board: 2-inches thick and 2-lb/cu. ft. nominal density.

END OF SECTION 230700

## SECTION 231123 - FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.
  - 6. Service meters.
  - 7. Mechanical sleeve seals.
  - 8. Grout.
  - 9. Concrete bases.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
  - 3. Minimum Operating Pressure of Service Meter: 5 psig
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less



- C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
- D. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.
- E. Natural-Gas System Pressures within Buildings: Three pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressures of more than 0.5 psig but not more than 2 psig, and is reduced again to pressures of 0.5 psig or less.
- F. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

## 1.5 SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Corrugated, stainless-steel tubing with associated components.
  - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 4. Pressure regulators. Indicate pressure ratings and capacities.
  - 5. Dielectric fittings.
  - 6. Mechanical sleeve seals.
  - 7. Escutcheons.
- 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. Shop Drawing Scale: 1/4 inch per foot
  - 2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.
- C. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
  - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. 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.
- E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

- F. Qualification Data: For qualified professional engineer.
- G. Welding certificates.
- H. Field quality-control reports.
- I. 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 according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- 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.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
  - 1. Notify Owner no fewer than three days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  - 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.
  - 6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dresser Piping Specialties; Division of Dresser, Inc.
      - 2) Smith-Blair, Inc.
    - b. Stainless-steel flanges and tube with epoxy finish.
    - c. Buna-nitrile seals.
    - d. Stainless-steel bolts, washers, and nuts.
    - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.

- f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. OmegaFlex, Inc.
    - b. Parker Hannifin Corporation; Parflex Division.
    - c. Titeflex.
    - d. Tru-Flex Metal Hose Corp.
  - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
  - 3. Coating: PE with flame retardant.
    - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 50 or less.
  - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
  - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
  - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
  - 7. Operating-Pressure Rating: 5 psig.
- C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.
  - 1. Aluminum Alloy: Alloy 5456 is prohibited.
  - 2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
  - 3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper-alloy fittings.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads shall comply with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K.
  - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  - 2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
    - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- E. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.
1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
- G. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.

- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
- 5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lyall, R. W. & Company, Inc.
    - 2) Mueller Co.; Gas Products Div.
    - 3) Perfection Corporation; a subsidiary of American Meter Company.
  - b. PE body with molded-in, stainless-steel support ring.
  - c. Buna-nitrile seals.
  - d. Acetal collets.
  - e. Electro-zinc-plated steel stiffener.
- 6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lyall, R. W. & Company, Inc.
    - 2) Mueller Co.; Gas Products Div.
    - 3) Perfection Corporation; a subsidiary of American Meter Company.
  - b. Fiber-reinforced plastic body.
  - c. PE body tube.
  - d. Buna-nitrile seals.
  - e. Acetal collets.
  - f. Stainless-steel bolts, nuts, and washers.
- 7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dresser Piping Specialties; Division of Dresser, Inc.
    - 2) Smith-Blair, Inc.
  - b. Stainless steel flanges and tube with epoxy finish.
  - c. Buna-nitrile seals.
  - d. Stainless steel bolts, washers, and nuts.
  - e. Factory-installed anode for steel-body couplings installed underground.

## 2.2 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Corrugated stainless-steel tubing with polymer coating.
  5. Operating-Pressure Rating: 0.5 psig.
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
  2. Nitrile seals.
  3. Hand operated with automatic shutoff when disconnected.
  4. For indoor or outdoor applications.
  5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
  2. End Connections: Grooved ends.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
  4. CWP Rating: 750 psi
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Perfection Corporation; a subsidiary of American Meter Company.



2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. 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. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-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. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McDonald, A. Y. Mfg. Co.
  - b. Mueller Co.; Gas Products Div.
  - c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, 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 shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Flowserve.
  - b. Homestead Valve; a division of Olson Technologies, Inc.
  - c. McDonald, A. Y. Mfg. Co.
  - d. Milliken Valve Company.
  - e. Mueller Co.; Gas Products Div.
  - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
2. Body: Cast iron, complying with ASTM A 126, 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 shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- J. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kerotest Manufacturing Corp.
    - b. Lyall, R. W. & Company, Inc.
    - c. Perfection Corporation; a subsidiary of American Meter Company
  2. Body: PE.
  3. Ball: PE.
  4. Stem: Acetal.
  5. Seats and Seals: Nitrile.
  6. Ends: Plain or fusible to match piping.
  7. CWP Rating: 80 psig
  8. Operating Temperature: Minus 20 to plus 140 deg
  9. Operator: Nut or flat head for key operation.
  10. Include plastic valve extension.
  11. Include tamperproof locking feature for valves where indicated on Drawings.
- K. Valve Boxes:
1. Cast-iron, two-section box.
  2. Top section with cover with "GAS" lettering.
  3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
  4. Adjustable cast-iron extensions of length required for depth of bury.
  5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.

## 2.5 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 Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide comparable product by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - d. Invensys.
  - e. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

### C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide comparable product by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Dungs.
  - d. Eclipse Combustion, Inc.
  - e. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - f. Invensys.
  - g. Maxitrol Company.
  - h. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 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 Inc.
  - b. Eaton Corporation; Controls Div.
  - c. Harper Wyman Co.
  - d. Maxitrol Company.
  - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig

## 2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.8 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
  - 3. Pressure Plates: Plastic
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## 2.9 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  - 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated
- E. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## 2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

## 2.11 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

### 3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "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 according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
  1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.



2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- H. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- J. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### 3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade 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. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
    - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished finish.
    - g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw;
- L. 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 in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. 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.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. 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.

- R. 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.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. 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.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### 3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground.
- 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 Division 05 Section "Metal Fabrications" for pipe bollards.

### 3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### 3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.8 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- B. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
  4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

### 3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.

- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.11 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel semigloss
    - d. Color: Yellow
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex semigloss.
    - d. Color: Yellow
  - 2. Alkyd System: MPI INT 5.1E.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior alkyd matching topcoat.

- c. Topcoat: Interior alkyd semigloss
- d. Color: Yellow

- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas according to NFPA 54, the International Fuel Gas Code, and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

### 3.14 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
  - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
  - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
  - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

## 3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
  - 1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  - 2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  - 3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  - 4. Aluminum tube with flared fittings and joints.
  - 5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

## 3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
  - 1. One-piece, bronze ball valve with bronze trim.
  - 2. Two-piece, full-port, bronze ball valves with bronze trim.
  - 3. Bronze plug valve.

END OF SECTION 231123



## SECTION 233113 – METAL DUCTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
  - 1. Rectangular ducts and fittings.
  - 2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
  - 3. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
  - 4. Duct liner.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

## 1.3 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. Drawings are diagrammatical and shall not be used as a shop drawing for fabrication. The contractor is responsible to coordinate with other trades and adjustments in elevation and routings as required to meet the project requirements.

## 1.4 SUBMITTALS

- A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) scale. Show fabrication and installation details for metal ducts.
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Duct layout indicating sizes and pressure classes.
  - 3. Elevations of top and bottom of ducts.

4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

- B. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports.
- B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, and the Michigan Department of Public Health Manual of Ventilation Systems for Food Service Establishments.

## 1.6 COORDINATION

- A. The contractor is responsible for coordination with other trades and maintaining required clearances for access and servicing of equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 (Z180) coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 2 mils thick on opposite surfaces.
- D. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- E. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and for exposed ducts.
- F. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- 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.

## 2.3 RECTANGULAR FITTING CONSTRUCTION

- A. General: Construct fittings in accordance with SMACNA HVAC Duct Construction Standards. Use low loss fittings.
- B. Elbows: Use full radius type with inside radius equal to the duct width except where space limits use. Where square elbows are shown or used, provide turning vanes. Use airfoil type vanes where duct velocities exceed 2000 fpm.
- C. Transitions: Construct transitions between duct sizes with tapered fittings. Use 22.5-degree maximum angle per side for diverging transitions and 30-degree maximum angle for converging transitions.
- D. Divided Flow Fittings: Use full radiused tees, square tees with turning vanes, or enlarged branch connections with 45-degree entry equal to 1/4 times the duct width. Round branch ducts to rectangular ducts may be conical or enlarged rectangular to round fittings with 45 degree enlarged entry. Round taps serving individual diffusers may be straight taps where branch duct velocities are less than 800 fpm.

## 2.4 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
  - 1. Manufacturers:

- a. CertainTeed Corp.; Insulation Group.
    - b. Johns Manville International, Inc.
    - c. Knauf Fiber Glass GmbH.
    - d. Owens Corning.
  2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
    - a. Thickness: 1 inch unless otherwise indicated.
    - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
    - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
    - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
  3. Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
  4. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
  5. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
- B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
1. Manufacturers:
    - a. Armstrong World Industries, Inc.
  2. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
    - a. Thickness: 3/4 inch.
    - b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
    - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
    - d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

## 2.5 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

- C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.6 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
  - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

## 2.7 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Lockformer.
  2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
  3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

## 2.8 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.
1. Manufacturers:
    - a. McGill AirFlow Corporation.
    - b. SEMCO Incorporated.
    - c. Dixie Sheet Metal Products.
    - d. Foremost.
    - e. Lindab.
- D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  - a. Manufacturers:
    - 1) Lindab Inc.
5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
  - a. Manufacturers:
    - 1) Ductmate Industries, Inc.
    - 2) McGill AirFlow Corporation.
    - 3) SEMCO Incorporated.
- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reducing entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.

- d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  - 4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  - 5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  - 6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  - 7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  - 8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
  - 9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
  - 10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  - 11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
  - 12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.
- H. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
- 1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
  - 2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
  - 3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction riveted and bonded.
  - 4. Other Fittings: Riveted and bonded joints.
  - 5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

## PART 3 - EXECUTION

### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
- 1. Supply Ducts: 2-inch wg.
  - 2. Supply Ducts (before Air Terminal Units): 6-inch wg.
  - 3. Supply Ducts (after Air Terminal Units): 1-inch wg.
  - 4. Return Ducts (Negative Pressure): 1-inch wg.
  - 5. Exhaust Ducts (Negative Pressure): 2-inch wg.
- B. All ducts shall be galvanized steel except as follows:



1. Range Hood Exhaust Ducts: Comply with NFPA 96.
  - a. Concealed: Carbon-steel sheet.
  - b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
  - c. Weld and flange seams and joints.
2. Dishwasher Hood Exhaust Ducts:
  - a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Weld and flange seams and joints.
  - b. Aluminum, with seams and laps arranged on top of duct.
3. Acid-Resistant (Fume-Handling) Ducts: PVC-coated galvanized steel with thicker coating on duct interior.
4. Underground Ducts: PVC-coated galvanized steel with thicker coating on duct exterior.

### 3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
  1. Offsets and transitions as required to coordinate with other trades and equipment are the responsibility of the contractor.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
  1. Where ducts pass over light fixtures, maintain a minimum elevation of 6-inches above finish ceiling, or more as required by the light fixtures.

- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches. Provide sheet metal flanges on both sides of walls, exposed or concealed for sound sensitive walls.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- O. Protect duct interiors from the elements and foreign materials until building is enclosed.
- P. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles where line of sight permits view of ducts. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.
- Q. Connections to existing equipment: Duct connections to equipment shall be full size to match the specific equipment used.
  - 1. Provide tapered transitions to equipment.
  - 2. Adjust ductwork configuration to match equipment used on project.

### 3.3 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS

- A. Repair damage to PVC coating with manufacturer's recommended materials.

### 3.4 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
  - 1. For pressure classes lower than 2-inch wg, seal transverse joints.
- B. Seal ducts before external insulation is applied.

### 3.5 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install concrete inserts before placing concrete.
- D. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
  - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  - 3. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
    - a. Allowable Leakage, Supply Duct Systems: 1 percent of design airflow.
    - b. Allowable Leakage, Return Duct Systems: 2 percent of design airflow.
    - c. Allowable Leakage, Exhaust Supply Duct Systems: 2 percent of design airflow.
    - d. Allowable Leakage, Supply Duct Systems, Terminals to Air Outlets: 2 percent of design airflow.
  - 4. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
  - 5. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113

## SECTION 233300 – AIR DUCT ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Flexible connectors.
  - 2. Louvers and Vents.

## 1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 FLEXIBLE CONNECTORS

- A. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
  - 1. Factory fabricate with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets.
  - 2. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
    - a. Minimum Weight: 26 oz./sq. yd..
    - b. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

## 2.3 LOUVERS AND VENTS

- A. General: Provide louvers and vents capable of withstanding the effects of gravity loads, wind loads and thermal movement. Wind loads shall be based on 30 pounds per square foot acting inward or outward.
1. Provide frame types and extended sills compatible with construction details.
    - a. Provide flanged frame where indicated.
  2. Provide screen at interior face of each exterior louver.
  3. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
- B. Materials:
1. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.
  2. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005.
  3. Galvanized Steel Sheet: ASTM A 653/A 653M, G 90 (Z275) zinc coating, mill phosphatized.
  4. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. [4] [6] finish.
  5. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel.
  6. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Fabrication, General:
1. Fabricate frames to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  2. Join frame members to each other and to louver blades with fillet welds concealed from view.
  3. Join frame members to each other and to louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view.
- D. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- E. Extruded Aluminum Double Drainable Blade
1. Frame: Four-inch deep .090 inch nominal wall thickness, 6064T5 extruded aluminum.
  2. Blades: 6063T5 extruded aluminum, .081 inch nominal wall thickness, double drainable blades at 45 deg. angle.
  3. Finish: Mill finish.
  4. Reference Product: Ruskin ELF811DD.
- F. Roll Formed Steel, Double Drainable Blade
1. Frame: 6-inch deep, 18-gage galvanized steel.
  2. Blades: 18-gage galvanized steel, 37½ deg angle, and with drain gutters in each blade.
  3. Screen: ½-inch mesh x 19-gage galvanized bird screen in a removable frame.
  4. Finish: Baked enamel finish in standard color selected by Architect.

G. Louver variations where scheduled on drawings:

1. Hinged frame.
2. Front or rear security bars.
3. Filter Rack for 2-inch filters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors.
- G. Install balance dampers on all branch ducts serving diffusers and grilles.
- H. Coordinate installation of roof curbs with general trades.

END OF SECTION 233300

## SECTION 235533 - GAS-FIRED UNIT HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes gas-fired unit heaters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of gas-fired unit heater.
  - 1. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment details.
  - 1. Prepare by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired unit heaters, as well as procedures and diagrams.
  - 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 wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, 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 equipment will be attached.
  - 2. Items penetrating roof and the following:
    - a. Vent and gas piping rough-ins and connections.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas-fired unit heaters 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. Fan Belts: One for each belt-driven fan size.

## 1.7 QUALITY ASSURANCE

- A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Lennox International, Inc.
  - 2. Modine Manufacturing Company.
  - 3. Reznor/Thomas & Betts Corporation.
  - 4. Sterling HVAC Products; Div. of Mestek Technology Inc.
  - 5. Trane; a brand of Ingersoll Rand.

## 2.2 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. Capacities and Characteristics: Refer to schedule on prints.



## 2.3 MANUFACTURED UNITS

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Indoor, separated combustion, power vented.
- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
  - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
  - 2. Discharge Louvers: Independently adjustable, horizontal blades.
- E. Accessories:
  - 1. Four-point suspension kit.
  - 2. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
  - 1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
  - 2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Motors:
  - 1. Enclosure Materials: Rolled steel.
  - 2. Efficiency: Premium efficient.
- J. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  - 1. Gas Control Valve: Single stage.
  - 2. Ignition: Electronically controlled electric spark with flame sensor.
  - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  - 4. Vent Flow Verification: Differential pressure switch to verify open vent.
  - 5. Control transformer.
  - 6. High Limit: Thermal switch or fuse to stop burner.
  - 7. Thermostat: Devices and wiring are specified in Section 230900 "Instrumentation and Control for HVAC."
  - 8. Wall-Mounted Thermostat:
    - a. Single stage.
    - b. Fan on-off-automatic switch.

- c. 24-V ac.
- d. 50 to 90 deg F operating range.

K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

#### 3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

#### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Vent Connections: Comply with Section 235100 "Breechings, Chimneys, and Stacks."
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

#### 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.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Verify bearing lubrication.
  3. Verify proper motor rotation.
  4. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 235533

## SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Work includes all electrical items and systems shown on the contract drawings and specified herein.
- B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.
- C. Include in the work all accessories and devices necessary for the intended operation of any system, whether or not specifically shown or specified.

#### 1.2 STANDARDS OF QUALITY

- A. The specifications establish the standard of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number.
- B. Where one product only is specifically identified by name of manufacturer's model number, the Contractor shall base his bid on the use of the name product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named.
- C. The Contractor may submit with his bid, the names of products which are proposed as substitutions for products named in specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.
- D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.
- E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

#### 1.3 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations.
  - 1. Submittals
  - 2. Maintenance Manuals
  - 3. Rough-ins
  - 4. Electrical Installations

#### 1.4 SUBMITTALS

- A. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.
- B. The Contractor shall check and verify pertinent field measurements, quantities of equipment and materials required.
- C. Submittals shall be identified by reference to project, the drawings, sections of specifications, or equipment symbols to which they relate.
- D. Shop drawings, when required, shall include:
  - 1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
  - 2. Equipment layouts drawn to scale as may be required.
  - 3. Wiring diagrams and schematics for equipment.
  - 4. Any special construction conditions.
  - 5. Other information/data as may be requested.
- E. All submittals shall identify the specific details of the product or assembly. All optional features being proposed shall be so noted, or the submittal will be rejected.
- F. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specification. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
- G. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

#### 1.5 MAINTENANCE MANUALS

- A. Prepare maintenance manuals including the following information for equipment items:
  - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions and lubrication charts and schedules.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

### 1.7 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

- A. Contractor shall acquire all permits and certificates.
- B. Contractor shall provide all labor and instruments required for tests and cleaning of systems.
- C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer and (1) electronic copy.
- D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of the test dates.

### 1.8 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

- A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:
  - 1. American Society for Testing Materials (ASTM).
  - 2. American National Standard Institute (ANSI).
  - 3. Underwriter's Laboratories, Inc. (UL).
  - 4. American Welding Society Code (AWSC).
  - 5. Local Building, Electrical, and Fire Codes.
  - 6. National Electrical Code (NEC).
  - 7. Service Rules and Regulations of Local Electrical Utility Company.
  - 8. National Electrical Manufacturer's Association (NEMA).
  - 9. U.S. Department of Health & Human Services "HRS-M-HF" 84-1.
  - 10. Occupational Safety and Health Act (OSHA).
  - 11. National Fire Protection Association (NFPA).
  - 12. Americans with Disabilities Act (ADA).

### PART 2 - PRODUCTS - Not Used.

### PART 3 - EXECUTION

#### 3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with requirements of the actual equipment to be connected.

### 3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components.
  2. Verify all dimensions by field measurements.
  3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
  8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
  9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
  10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
  11. Install access panel or doors where units are concealed behind finished surfaces.
  12. Install systems, material, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
  13. Coordinate all electrical requirements with other trades and their shop drawings prior to installing conduit, wire, switches and breakers. Notify engineer of any discrepancies between document and actual supplied equipment.

### 3.3 CUTTING AND PATCHING

- A. General: Performing cutting and patching in accordance with the following requirements:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover work to provide for installation of ill-timed work.
    - b. Remove and replace defective work.
    - c. Remove and replace work not conforming to requirements of the contract documents.
    - d. Remove samples of installed work as specified for testing.

- e. Upon written instruction from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.

END OF SECTION 260010



## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

#### 1.2 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

### PART 2 - PRODUCTS – Not Used.

### PART 3 - EXECUTION

#### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 260500

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

#### 1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

#### 2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Stranded for No. 12 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
    - a. Transfer switches.
    - b. All 100A and above feeders.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report 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.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding 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. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
      - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      - 2) Include recommended testing intervals.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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 UL 467 for grounding and bonding materials and equipment.

### 2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

### 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 5/8 by 96 inches.



## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. 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 No. 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 according to written instructions by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the 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 No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  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 the record of tests and observations. Include the 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.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  4. Substations and Pad-Mounted Equipment: 5 ohms.
  5. Manhole Grounds: 10 ohms.

- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

#### 1.4 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

### PART 2 - PRODUCTS

#### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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.

- D. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements.
- C. Anchor equipment to concrete base.
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.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Boxes, enclosures, and cabinets.
4. Handholes and boxes for exterior underground cabling.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  1. Fittings for EMT:
    - a. Material: Die cast.
    - b. Type: Setscrew.



- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. LFNC: Comply with UL 1660.
- D. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: Comply with UL 514B.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Gangable boxes are prohibited.
- J. Metal Floor Boxes:

1. Material: Cast metal
2. Type: Fully adjustable
3. Shape: Rectangular
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

K. Nonmetallic Floor Boxes: Nonadjustable

1. Listing and labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. NewBasis.
  - d. Oldcastle Precast, Inc.
  - e. Quazite: Hubbell Power System, Inc.
  - f. Synertech Moulded Products.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "TELEPHONE".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC,.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: GRC.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental

- temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. 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.
- Z. 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.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, 24 inches below grade.
- E. 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.

- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 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."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 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



**SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

**PART 2 - PRODUCTS****2.1 SLEEVES****A. Wall Sleeves:**

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

**B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.****C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.****2.2 SLEEVE-SEAL SYSTEMS****A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.**

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.

#### 1.2 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### 1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

### 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

### 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

## 2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
- C. Description:
  - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 2. Overall Thickness: 5 mils.
  - 3. Foil Core Thickness: 0.35 mil.

4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

## 2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.



- 3) Phase C: Blue.
- c. Colors for 480/277-V Circuits:
  - 1) Phase A: Brown.
  - 2) Phase B: Orange.
  - 3) Phase C: Yellow.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. 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.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Emergency system boxes and enclosures.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.
    - i. Variable-speed controllers.
    - j. Power transfer equipment.
    - k. Power-generating units.
    - l. Light control panels.

END OF SECTION 260553

## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Photoelectric switches.
  - 2. Indoor occupancy sensors.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. NSi Industries LLC; TORK Products.
  - 4. Tyco Electronics; ALR Brand.
- B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

## 2.2 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hubbell Building Automation, Inc.
  2. Leviton Manufacturing Co., Inc.
  3. Lightolier Controls.
  4. Lutron Electronics Co., Inc.
  5. Sensor Switch, Inc.
  6. Steinel
  7. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operation: 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.
  3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  5. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. 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- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation, Inc.
  2. Leviton Manufacturing Co., Inc.
  3. Lightolier Controls.
  4. Lutron Electronics Co., Inc.
  5. Sensor Switch, Inc.
  6. Steinel
  7. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag OC:

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: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. Wall-Switch Sensor Tag OC2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
9. Provide second relay for exhaust fan control.

## 2.4 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 SENSOR INSTALLATION

- 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 written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical 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.
- B. Perform the following 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. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.



### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors 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.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current, and voltage ratings.
    - c. Short-circuit current rating of panelboards and overcurrent protective devices.
    - d. Evidence of NRTL listing for series rating of installed devices.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
    - f. Time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
  - 2. Wiring Diagrams: Power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.
- B. Typed updated panelboard schedules for installation in panelboards.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton – Cutler-Hammer
- B. Source Limitations: Obtain panelboards and power distribution components from a single manufacturer.
- C. Enclosures: Flush- or surface-mounted cabinets as shown on the floor plans.
1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Directory Card: Inside panelboard door, mounted in transparent card holder.
- D. Incoming Mains Location: Top or bottom depending on panel feeders.
- E. Phase, Neutral, and Ground Buses:
1. Base Bid: Hard-drawn copper, 98 percent conductivity.
  2. Alternate E1: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit breaker line connections.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Main and Neutral Lugs: Compression or Mechanical type.
  2. Ground Lugs and Bus Configured Terminators: Compression or Mechanical type.
  3. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
  5. Subfeed (Double) Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

- G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by NRTL.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Mains: Circuit breaker or Lugs only and noted on the panel schedules.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit Breaker or Main Lugs only.
- C. Branch Overcurrent Protective Devices:
  - 1. 208Y120 Volt:
    - a. 15 amps through 70 amps: Plug-in circuit breakers, replaceable without disturbing adjacent units.
    - b. Over 70 amps: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
  - 2. 480Y277 Volt: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECT AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating 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. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (30-mA trip).
3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Mechanical or Compression style, suitable for number, size, trip ratings, and conductor materials.
  - c. Application Listing: Appropriate for application; Type SWD for switching 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.
  - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - f. Handle Padlocking Device: Fixed attachment, for locking circuit breaker handle in on or off position.
  - g. Handle Clamp: Loose attachment, for holding circuit breaker handle in on position.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 72 inches above finished floor, unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
  1. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below the floor for areas with accessible spaces below the finished floor.
- G. Arrange conductors in gutters into groups and bundled and loosely wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and as noted on the drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical.
  - 2. Correct malfunctioning units on site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

#### 2.2 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).

- d. Pass & Seymour; 5361 (single), 5362 (duplex).

## 2.3 GFCI RECEPTACLES

### A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

### B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; VGF20.
  - b. Hubbell; GFR5352L.
  - c. Pass & Seymour; 2095.
  - d. Leviton; 7590.

## 2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

### A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper Crouse-Hinds.
  - b. EGS/Appleton Electric.
  - c. Killark; Division of Hubbell Inc.

## 2.5 TWIST-LOCKING RECEPTACLES

### A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; CWL520R.
  - b. Hubbell; HBL2310.
  - c. Leviton; 2310.
  - d. Pass & Seymour; L520-R.

## 2.6 TOGGLE SWITCHES

### A. Comply with NEMA WD 1, UL 20, and FS W-S-896.



## B. Switches, 120/277 V, 20 A:

## 1. Products: Subject to compliance with requirements, provide one of the following:

## 1) Single Pole:

- a) Cooper; AH1221.
- b) Hubbell; HBL1221.
- c) Leviton; 1221-2.
- d) Pass & Seymour; CSB20AC1.

## 2) Two Pole:

- a) Cooper; AH1222.
- b) Hubbell; HBL1222.
- c) Leviton; 1222-2.
- d) Pass & Seymour; CSB20AC2.

## 3) Three Way:

- a) Cooper; AH1223.
- b) Hubbell; HBL1223.
- c) Leviton; 1223-2.
- d) Pass & Seymour; CSB20AC3.

## 4) Four Way:

- a) Cooper; AH1224.
- b) Hubbell; HBL1224.
- c) Leviton; 1224-2.
- d) Pass & Seymour; CSB20AC4.

## C. Pilot-Light Switches, 20 A:

## 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Leviton; 1221-LH1.
- d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

## 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

## 2.7 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

- C. LED Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.9 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.
- D. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.
- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

## 1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current rating.
  - 4. UL listing for series rating of installed devices.
  - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

### 1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Available Manufacturers:
  - 1. Eaton Corporation; Cutler-Hammer Products.
  - 2. General Electric Co.; Electrical Distribution & Control Division.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D/Group Schneider.
- B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. 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; and labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

## 2.2 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
  - 1. Inspect mechanical and electrical connections.
  - 2. Verify switch and relay type and labeling verification.
  - 3. Verify rating of installed fuses.
  - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case 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. Infrared Scanning:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
  - b. Instruments, Equipment and Reports:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - 2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816



## SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Combination full-voltage magnetic motor controllers.
  - 2. Enclosures.
  - 3. Accessories.
  - 4. Identification.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

#### 1.4 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: For each type of magnetic controller.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
  - a. Listing document proving Type 2 coordination.
7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for magnetic controllers, 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.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for magnetic controllers and installed components.

- b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
- c. Manufacturer's written instructions for setting field-adjustable overload relays.
- d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Indicating Lights: Two of each type and color installed.
  - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W.

#### 1.10 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 23 deg F (minus 5 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m) for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

## 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 use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Component Importance Factor: 1.5.

### 2.2 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Corporation; Cutler-Hammer Products.
  2. General Electric Company; GE Industrial Systems.
  3. Siemens Energy and Automation; Industrial Products Division.
  4. Square D.
  5. Yaskawa.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
  1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. Spare CPT Capacity as Indicated on Drawings: 50 VA.
- G. Overload Relays:
  1. Thermal Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  2. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- H. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- I. Digital communication module, using RS-485 Modbus, RTU protocol, 2 to 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
  1. Instantaneous rms current each phase, and 3-phase average.
  2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
  3. Active Energy (kWh): 3-phase total.
  4. Power Factor: Each phase and 3-phase total.
- J. Fusible Disconnecting Means:
  1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
  2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- K. Nonfusible Disconnecting Means:
  1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
  2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- L. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

M. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

## 2.3 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

## 2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
    - a. Push Buttons: As indicated in the controller schedule.
    - b. Pilot Lights: As indicated in the controller schedule.
  2. Elapsed Time Meters: Heavy duty with digital readout in hours resettable.
  3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.
  1. Phase-failure.
  2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
  3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.

- C. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

## 2.5 IDENTIFICATION

- A. Controller Nameplates: As described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
  - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
  - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      - 1) Location designation.
      - 2) Nominal voltage.
      - 3) Flash protection boundary.
      - 4) Hazard risk category.
      - 5) Incident energy.
      - 6) Working distance.
      - 7) Engineering report number, revision number, and issue date.
    - b. Labels shall be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
  - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Inspect contactors:
      - 1) Verify mechanical operation.
      - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.



- f. Motor-Running Protection:
    - 1) Verify overload element rating is correct for its application.
    - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
3. Electrical Tests:
- a. 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. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
  - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - c. Test motor protection devices according to manufacturer's published data.
  - d. Test circuit breakers as follows:
    - 1) Operate the circuit breaker to ensure smooth operation.
    - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
  - e. Perform operational tests by initiating control devices.
- F. Prepare test and inspection reports.

### 3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
  2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
  3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262913.03

## SECTION 265100 - INTERIOR LIGHTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast, including BF.
  - 4. Energy-efficiency data.
  - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. 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.
- C. Installation instructions.

## 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
  - 2. Complete schedule at end of specification.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. LED Modules: 1 for every 25 of each type and rating installed. Furnish at least one of each type.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  2. Warranty Period for Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.
- B. Special Warranty for LEDs and Drivers: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

## 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. 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.
- E. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. LED information, manufacturer, wattage.
    - c. CCT and CRI for all luminaires.

## 2.3 EMERGENCY LED POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
  - 1. Emergency Connection: Operate LED continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  - 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 3. Battery: Sealed, maintenance-free, nickel-cadmium type.

4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

## 2.4 LED DRIVER

- A. High efficiency.
- B. If installed outside, shall be fully encased in potting for moisture resistance.

## 2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## 2.6 LEDs

- A. High-brightness LEDs mounted to a metal core circuit board.
- B. Provide 3500 K color temperature, unless otherwise noted on drawings.
- C. Provide color accuracy (CRI) 80.

## 2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with 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 fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

END OF SECTION 265100



## SECTION 265600 - EXTERIOR LIGHTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Exterior luminaires with LEDs light source and drivers.
  - 2. Poles.
  - 3. Utility company rebate forms.

## 1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
  - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

## 1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 2. Details of attaching luminaires and accessories.
  - 3. Details of installation and construction.
  - 4. Luminaire materials.
  - 5. Drivers, including energy-efficiency data.
  - 6. LEDs, including life, output, and energy-efficiency data.
  - 7. Materials, dimensions, and finishes of poles.
  - 8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  - 9. Anchor bolts and bolt circle pattern for poles.
- B. Shop Drawings:
  - 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  - 2. Wiring Diagrams: Power wiring.

- C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- D. Qualification Data: For agencies providing photometric data for lighting fixtures.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
  - 2. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Two complete luminaires, identical to the installed perimeter luminaires.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Refer to Lighting Schedule on Sheet E-100.

### 2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. The Luminaire shall be designed and manufactured in the United States. Global components will be allowed provided greater than 50 percent of the parts and labor are sourced in the United States.
- B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- C. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

## 2.3 OPTICAL REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Impact resistant polycarbonate remote phosphor plate with a thickness of at least 0.08 inches.
2. The remote phosphor plate shall meet or exceed the EN 62262 impact test with a rating of IK07 or better.
3. The polycarbonate remote phosphor shall meet or exceed the ASTM G154 Cycle 1 UV stability tests.
4. A diffuse, highly reflective mixing chamber with a reflectivity of  $\geq 97\%$ .
5. The optical system shall meet or exceed an IP65 rating.

## 2.4 PHOTOMETRIC REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Nominal CCT of 3000K, adjustable with different remote phosphor plates.
2. Typical CRI of  $\geq 70$ , adjustable with different remote phosphor plates
3. Minimum initial luminaire efficacy of 90 lm/W (3000K 80CRI)
4. Two adjustable light arrays from 0 to 30 degrees
5. Lumen output  $> 20,000$  (3000K, 80CRI)
6. The luminaire shall be registered with the US Department of Energy Lighting Facts program.

## 2.5 ELECTRICAL SYSTEM REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Power supply rated at IP65 or better.
2. Luminaire shall have an integrated universal 480 VAC input.
3. Operating temperature of  $-40^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$  or wider.
4. UL certified power supply providing constant current with a voltage below 60 volts DC.
5. THD (Total Harmonic Distortion) from the power supply shall be 10% or lower.

## 2.6 LIGHT ENGINE REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. L70 lumen maintenance shall exceed 96,000 hours.
2. LED LM-80 data must show  $< 0.1\%$  decrease in output after 10,000 hours.
3. The light output shall have 5 or lower SDCM (Standard Deviation of Color Matching) consistency from fixture to fixture and over the L70 life of the product.
4. Polycarbonate based remote phosphor plate with a typical lm/Wrad efficacy of 230 or better.
5. Highly reflective, diffuse mixing chamber with a diffuse reflectivity rating of 97% or greater.
6. Metal core LED circuit board.

## 2.7 MECHANICAL REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Effective Projected Area (EPA) not to exceed 3.50.
2. A weight  $\leq$  50 pounds (not including additional controls or 480VAC option).
3. Normal operation range from -40 C to +45C or wider.
4. Housing constructed of die cast aluminum, extruded aluminum and stainless steel.
5. Cast parts shall be finished in a corrosion resistant polyester powder paint.
6. Internally mounted drivers.
7. Corrosion resistant fasteners.
8. Integrated heat sink fins designed to reduce water and debris collection.
9. Support for both vertical and horizontal pipe mounting, including adjustment from -5 to +95 degrees.
10. A bolt-type slip fit mount should accept 2.5 to 2.0 inch OD pipes.
11. Optional custom paint colors.

## PART 3 - EXECUTION

### 3.1 LUMINAIRE INSTALLATION

#### A. Fasten luminaire to structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

#### B. Adjust luminaires that require field adjustment or aiming.

1. Contractor shall coordinate aiming of the newly installed luminaires during construction with MDOC and MDTMB staff. Contractor shall include up to three aiming iterations.
2. Preliminary aiming of fixtures will occur on the day of installation.
3. Final aiming of fixtures shall occur after normal working hours during a period of darkness. The aiming shall be scheduled one week in advance with MDOC and MDTMB staff. MDOC and MDTMB staff will be present during aiming operations to confirm proper aiming of each fixture.
4. Corrective aiming of fixtures as required to ensure proper coordination with newly installed cameras shall occur after installation and start-up of camera equipment.

### 3.2 CORROSION PREVENTION

- #### A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.3 GROUNDING

- #### A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
  2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole.
  2. Install grounding conductor and conductor protector.
  3. Ground metallic components of pole accessories and foundations.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
- C. Contractor shall provide (2) night aiming sessions.
- D. Contractor shall provide (1) aiming session after CCTV camera installation.
- E. Verify that new system is fully operational and compatible with the existing photocell and/or time clock controls.

### 3.7 UTILITY COMPANY LIGHTING REBATES

- A. Contractor shall coordinate with the local Electric Utility Company for all available rebates, to be paid to the Owner, for the replacement of HID luminaires with LED luminaires as part of this project.
- B. Provide the utility company with all required documentation including wattage reduction, luminaire specification sheets, purchase invoices, sample Owner utility bill and W-9 forms.
- C. Contractor shall complete rebate application forms and submit them along with all required documentation to utility company upon project completion.

END OF SECTION 265600

## SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

#### 1.02 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meetings
  - 1. Preinstallation Conference: Conduct conference at Project site.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

#### 1.04 INFORMATIONAL SUBMITTALS

- A. Material certificates.
- B. Material test reports.
- C. Floor surface flatness and levelness measurements.

#### 1.05 QUALITY ASSURANCE

- A. Qualifications
  - 1. 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.
    - a. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
  - 2. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- B. 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."
- C. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

## PART 2 - PRODUCTS

## 2.01 FORM-FACING MATERIALS

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

## 2.02 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.
- C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.
- D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

## 2.03 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 or Type III, gray. Where not exposed as a finished surface in the final construction, supplement with the following:
    - a. Fly Ash: ASTM C 618, Class F.
    - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, graded.
  - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
  - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- C. Water: ASTM C 94/C 94M and potable.

## 2.04 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- 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.

## 2.05 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class B. Include manufacturer's recommended adhesive or pressure-sensitive tape.

## 2.06 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.
- E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

## 2.07 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

## 2.08 CONCRETE MIXTURES

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
- B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 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.
- D. Proportion normal-weight concrete mixture as follows:
  - 1. Minimum Compressive Strength: As indicated on Drawings at 28 days.
  - 2. Maximum Water-Cementitious Materials Ratio: 0.50, unless otherwise indicated.
  - 3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

## 2.09 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.

## 2.10 FABRICATING REINFORCEMENT

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

# PART 3 - EXECUTION

## 3.01 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. Do not chamfer exterior corners and edges of permanently exposed concrete.

## 3.02 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

## 3.03 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  1. Lap joints 6 inches and seal with manufacturer's recommended tape.

## 3.04 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

## 3.05 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- 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.

### 3.06 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. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
  - 1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
- C. Cold-Weather Placement: Comply with ACI 306.1.
- D. Hot-Weather Placement: Comply with ACI 301.

### 3.07 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  - 1. Apply to concrete surfaces to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. 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.

### 3.08 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
  - 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller 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.

### 3.09 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

### 3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

END OF SECTION 03 30 00

## SECTION 04 22 00 – Concrete Masonry Unit

### 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. Concrete masonry units.
  - 2. Pre-faced concrete masonry units.
  - 3. Mortar and grout.
  - 4. Steel reinforcing bars.
  - 5. Masonry-joint reinforcement.
  - 6. Embedded flashing.
  - 7. Miscellaneous masonry accessories.

#### 1.3 DEFINITIONS

- A. CMU(s): Concrete masonry unit(s).
- B. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Not required.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For the following:
  - 1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
  - 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315
  - 3. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.
- C. Samples for Initial Selection:

1. CMU.
2. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:

1. CMU.
2. Color mortar. Make Samples using same sand and mortar ingredients to be used on Project.

## 1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Material Certificates: For each type and size of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For masonry units include data and calculations establishing average net-area compressive strength of units.
2. Integral water repellent used in CMUs.
3. Cementitious materials. Include name of manufacturer, brand name, and type.
4. Mortar admixtures.
5. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
6. Grout mixes. Include description of type and proportions of ingredients.
7. Reinforcing bars.
8. Joint reinforcement.
9. Anchors, ties, and metal accessories.

C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91/C 91M for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to TMS 402/602.

E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

## 1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1093 for testing indicated.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.9 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. 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 402/602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F (4 deg C) and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 402/602.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Units similar to:
  1. Grand Blanc Cement Products
  2. Smooth face units
  3. 8"x8"x16" nominal
  4. Color: natural

### 2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
  1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to TMS 402/602.
  2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

### 2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 402/602 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.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.



1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

## 2.4 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.
  2. Provide square-edged units for outside corners unless otherwise indicated.
- B. Integral Water Repellent: Provide units made with integral water repellent for all blocks.
  1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514/E 514M as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
      - 1) Euclid Chemical Company (The); an RPM company.
      - 2) Other approved manufactures.
- C. CMUs: ASTM C 90.
  1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi (19.3 MPa).
  2. Density Classification: Normal weight.
  3. Size (Width): Manufactured to dimensions 3/8 inch (10 mm) less-than-nominal dimensions.
  4. Exposed Faces: Provide color and texture matching the range represented by Architect's sample.

## 2.5 MORTAR AND GROUT MATERIALS

- A. Mortar Cement: ASTM C 1329/C 1329M.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Lafarge North America Inc.
    - b. Other approved manufacturer.

- 
- B. Mortar Pigments: Natural and synthetic iron oxides and chromium oxides, compounded for use in mortar mixes and complying with ASTM C 979/C 979M. Use only pigments with a record of satisfactory performance in masonry mortar.
1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterColor (Pre-2014: RHEOCOLOR L) or a comparable product by one of the following:
    - a. Euclid Chemical Company (The); an RPM company.
    - b. Other approved manufacturer.
- C. Colored Cement Products: Packaged blend made from mortar cement and mortar pigments, all complying with specified requirements, and containing no other ingredients.
1. Colored Masonry Cement:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cemex S.A.B. de C.V.
      - 2) Essroc.
      - 3) Holcim (US) Inc.
      - 4) Lafarge North America Inc.
      - 5) Lehigh Hanson; HeidelbergCement Group.
      - 6) Other approved manufacturer.
  2. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors.
  3. Pigments shall not exceed 5 percent of mortar cement by weight.
- D. Aggregate for Mortar: ASTM C 144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  2. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.
  3. White-Mortar Aggregates: Natural white sand or crushed white stone.
  4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.
- E. Aggregate for Grout: ASTM C 404.
- F. Epoxy Pointing Mortar: ASTM C 395, epoxy-resin-based material formulated for use as pointing mortar for glazed or pre-faced masonry units (and approved for such use by manufacturer of units); in color indicated or, if not otherwise indicated, as selected by Architect from manufacturer's colors.
- G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
  - a. Euclid Chemical Company (The); an RPM company.
  - b. Other approved manufacturer.
- H. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs containing integral water repellent from same manufacturer.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
    - a. Euclid Chemical Company (The); an RPM company.
    - b. Other approved manufacturer.
- I. Water: Potable.

## 2.6 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, 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 (3.77-mm) steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dur-O-Wal; a Hohmann & Barnard company.
    - b. Heckmann Building Products, Inc.
    - c. Hohmann & Barnard, Inc.
    - d. Lock Rite.
    - e. Wire-Bond.
    - f. Other approved manufacturer.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A 951/A 951M.
  1. Interior Walls: Hot-dip galvanized carbon steel.
  2. Exterior Walls: Hot-dip galvanized carbon steel.
  3. Wire Size for Side Rods: 0.148-inch (3.77-mm) diameter.
  4. Wire Size for Cross Rods: 0.148-inch (3.77-mm) diameter.
  5. Spacing of Cross Rods: Not more than 16 inches (407 mm) o.c.
  6. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.

## 2.7 TIES AND ANCHORS

- A. General: Ties and anchors shall extend at least 1-1/2 inches (38 mm) into masonry but with at least a 5/8-inch (16-mm) cover on outside face.

- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 641/A 641M, Class 1 coating.
2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M, with ASTM A 153/A 153M, Class B-2 coating.
3. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
4. Galvanized-Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 (Z180) zinc coating.
5. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
6. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.
7. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

## 2.8 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:

1. Stainless Steel: ASTM A 240/A 240M or ASTM A 666, Type 304, 0.016 inch (0.40 mm) thick.
2. Fabricate continuous flashings in sections 96 inches (2400 mm) long minimum, but not exceeding 12 feet (3.7 m). Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch (76-mm) intervals along length of flashing to provide an integral mortar bond.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cheney Flashing Company.
    - 2) Hohmann & Barnard, Inc.
    - 3) Keystone Flashing Company, Inc.
    - 4) Sandell Manufacturing Co., Inc.
    - 5) Other approved manufacturer.
4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.
5. Fabricate through-wall flashing with drip edge where indicated. Fabricate by extending flashing 1/2 inch (13 mm) out from wall, with outer edge bent down 30 degrees.
6. Solder metal items at corners.

- B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. Rubberized-Asphalt Flashing: Composite flashing product consisting of a pliable, adhesive rubberized-asphalt compound, bonded to a high-density, cross-laminated polyethylene film to produce an overall thickness of not less than 0.040 inch (1.02 mm).

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- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Advanced Building Products Inc.
    - 2) Carlisle Coatings & Waterproofing Inc.
    - 3) Fiberweb, Clark Hammerbeam Corp.
    - 4) GCP Applied Technologies Inc. (formerly Grace Construction Products).
    - 5) Heckmann Building Products, Inc.
    - 6) Hohmann & Barnard, Inc.
    - 7) Polyguard Products, Inc.
    - 8) W. R. Meadows, Inc.
    - 9) Williams Products, Inc.
    - 10) Wire-Bond.
  - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
2. Butyl Rubber Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.040 inch (1.02 mm).
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) DuPont Building Innovations: E. I. du Pont de Nemours and Company.
      - 2) GCP Applied Technologies Inc. (formerly Grace Construction Products).
      - 3) Protecto Wrap Company.
      - 4) Raven Industries, Inc.
      - 5) Wire-Bond.
    - b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
  3. Elastomeric Thermoplastic Flashing: Composite flashing product consisting of a polyester-reinforced ethylene interpolymer alloy.
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hohmann & Barnard, Inc.
      - 2) Hyload, Inc.
      - 3) Mortar Net Solutions.
      - 4) Wire-Bond.
    - b. Monolithic Sheet: Elastomeric thermoplastic flashing, 0.040 inch (1.02 mm) thick.
    - c. Self-Adhesive Sheet: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of adhesive.
    - d. Self-Adhesive Sheet with Drip Edge: Elastomeric thermoplastic flashing, 0.025 inch (0.64 mm) thick, with a 0.015-inch- (0.38-mm-) thick coating of rubberized-

asphalt adhesive. Where flashing extends to face of masonry, rubberized-asphalt coating is held back approximately 1-1/2 inches (38 mm) from edge.

- 1) Color: Tan/buff.
- e. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.
4. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637/D 4637M, 0.040 inch (1.02 mm) thick.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Carlisle Coatings & Waterproofing Inc.
    - 2) Firestone Specialty Products.
    - 3) Heckmann Building Products, Inc.
    - 4) Hohmann & Barnard, Inc.
    - 5) Sandell Manufacturing Co., Inc.
    - 6) Wire-Bond.
- C. Application: Unless otherwise indicated, use the following:
  1. Where flashing is indicated to receive counterflashing, use metal flashing.
  2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
  3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
  4. Where flashing is fully concealed, use metal flashing or flexible flashing.
- D. Single-Wythe CMU Flashing System: System of CMU cell flashing pans and interlocking CMU web covers made from UV-resistant, high-density polyethylene. Cell flashing pans have integral weep spouts designed to be built into mortar bed joints and that extend into the cell to prevent clogging with mortar.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Mortar Net Solutions.
- E. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or PVC.

- B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.
- C. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D 226/D 226M, Type I (No. 15 asphalt felt).

## 2.10 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 mortar cement mortar unless otherwise indicated.
  - 3. For exterior masonry, use mortar cement mortar.
  - 4. For reinforced masonry, use mortar cement mortar.
  - 5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion 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 mortar parge coats, use Type S.
  - 4. 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.
- D. Pigmented Mortar: Use colored cement product.
  - 1. Pigments shall not exceed 5 percent of mortar cement by weight.
  - 2. Mix to match Architect's sample.
  - 3. Application: Use pigmented mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
    - b. Pre-faced CMUs.
    - c. Cast-stone trim units.
- E. Colored-Aggregate Mortar: Produce required mortar color by using colored aggregates and natural color or white cement as necessary to produce required mortar color.
  - 1. Mix to match Architect's sample.

- 
2. Application: Use colored-aggregate mortar for exposed mortar joints with the following units:
    - a. Decorative CMUs.
- F. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 402/602 for dimensions of grout spaces and pour height.
  2. Conventional Grout:
    - a. Proportion grout in accordance with ASTM C 476, paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa).
    - b. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C 143/C 143M.
    - c. Mid-Range or High-Range Water-Reducing Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
  3. Self-Consolidating Grout: Proportion grout according to ASTM C 476, for specified 28-day compressive strength indicated, but not less than 2000 psi (14 MPa). Jobsite proportioning of self-consolidating grout is not permitted. Do not add water at jobsite except according to self-consolidating grout manufacturer's instructions.
    - a. High-Range Water-Reducing Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterGlenium Series (Pre-2014: Glenium Series) or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
    - b. Viscosity-Modifying Admixture:
      - 1) Basis-of-Design Product: Subject to compliance with requirements, provide BASF Corporation; Admixture Systems; MasterMatrix VMA Series (Pre-2014: Rheomac VMA Series) or a comparable product by one of the following:
        - a) Euclid Chemical Company (The); an RPM company.
    - c. Slump Flow: 24 to 30 inches (600 to 750 mm) as determined in accordance with ASTM C 1611/C 1611M.
    - d. Visual Stability Index (VSI): Less than or equal to 1 as determined in accordance with ASTM C 1611/C 1611M, Appendix X.1.



- G. Epoxy Pointing Mortar: Mix epoxy pointing mortar to comply with mortar manufacturer's written instructions.
  - 1. Application: Use epoxy pointing mortar for exposed mortar joints with pre-faced CMUs.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
  - 1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
  - 2. Verify that foundations are within tolerances specified.
  - 3. Verify that reinforcing dowels are properly placed.
  - 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.
- C. 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.

#### 3.3 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 (12 mm) or minus 1/4 inch (6 mm).
  - 2. For location of elements in plan, do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
  - 3. For location of elements in elevation, do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) 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 (6 mm in 3 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) 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 (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2-inch (12-mm) maximum.
5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2-inch (12-mm) maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2-inch (12-mm) maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch (1.5 mm).

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For exposed bed joints, do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch (3 mm).
3. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
4. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

### 3.4 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 bond pattern indicated on Drawings; do not use units with less-than-nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

- F. 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.
- G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
  - 1. Install compressible filler in joint between top of partition and underside of structure above.
  - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
  - 3. Wedge nonload-bearing partitions against structure above with small pieces of tile, slate, or metal. Fill joint with mortar after dead-load deflection of structure above approaches final position.
  - 4. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 078443 "Joint Firestopping."

### 3.5 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. Set cast-stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.
  - 1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
  - 2. Wet joint surfaces thoroughly before applying mortar.
  - 3. Rake out mortar joints for pointing with sealant.
- D. Rake out mortar joints at pre-faced CMUs to a uniform depth to match existing and point with epoxy mortar to comply with epoxy-mortar manufacturer's written instructions.
- E. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- F. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

- G. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

### 3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch (16 mm) on exterior side of walls, 1/2 inch (13 mm) elsewhere. Lap reinforcement a minimum of 6 inches (150 mm).
  - 1. Space reinforcement not more than 16 inches (406 mm) o.c.
  - 2. Space reinforcement not more than 8 inches (203 mm) o.c. in foundation walls and parapet walls.
  - 3. Provide reinforcement not more than 8 inches (203 mm) above and below wall openings and extending 12 inches (305 mm) beyond openings.
- 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.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

### 3.7 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry using one of the following methods:
  - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.
  - 2. Install preformed control-joint gaskets designed to fit standard sash block.
  - 3. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar, or rake out joint for application of sealant.
  - 4. Install temporary foam-plastic filler in head joints, and remove filler when unit masonry is complete for application of sealant.

### 3.8 LINTELS

- A. Provide steel beam lintels where shown and where openings of more than 12 inches (305 mm) for brick-size units and 24 inches (610 mm) for block-size units are shown without structural steel or other supporting lintels.
- B. Provide minimum bearing of 8 inches (200 mm) at each jamb unless otherwise indicated.

### 3.9 FLASHING

- A. General: Install embedded flashing at ledges and other obstructions to downward flow of water in wall where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At lintels, extend flashing a minimum of 6 inches (150 mm) into masonry at each end. At heads and sills, extend flashing 6 inches (150 mm) at ends and turn up not less than 2 inches (50 mm) to form end dams.
  - 3. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches (38 mm) or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 4. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 079200 "Joint Sealants" for application indicated.
  - 5. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal drip edge.
  - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch (13 mm) back from outside face of wall, and adhere flexible flashing to top of metal flashing termination.
  - 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install single-wythe CMU flashing system in bed joints of CMU walls where indicated to comply with manufacturer's written instructions. Install CMU cell pans with upturned edges located below face shells and webs of CMUs above and with weep spouts aligned with face of wall. Install CMU web covers so that they cover upturned edges of CMU cell pans at CMU webs and extend from face shell to face shell.
- D. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

### 3.10 REINFORCED UNIT MASONRY INSTALLATION

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
  - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.

2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 402/602.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
1. Comply with requirements in TMS 402/602 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 60 inches (1520 mm).

### 3.11 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 C in TMS 402/602 (formerly ACI 530).
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. (464 sq. m) of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.
- G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.
- I. Prism Test: For each type of construction provided, according to ASTM C 1314 at 7 days and at 28 days.

### 3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
  - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

### 3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 06 05 73

PRESERVATIVE TREATED LUMBER AND PLYWOOD

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Preservative treatment of lumber and plywood.

1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry - Rough Carpentry.
- B. Section 06 16 00 - Wood Sheathing.

1.3 REFERENCES

- A. American Wood Protection Association (AWPA).
- B. ASTM International (ASTM):
  - 1. ASTM D5564 - Standard Test Method For Determination Of The Total Ammonia Contained In Sulfonated Or Sulfated Oils
  - 2. ASTM E84 - Standard Test Method For Surface Burning Characteristics Of Building Materials
- C. Environmental Protection Agency (EPA)
- D. Federal Standard USA:
  - 1. TT-W-550 - WOOD PRESERVATIVE: CHROMATED COPPER ARSENATE MIXT
  - 2. TT-W-571 - Wood Preservation: Treating Practices
- E. International Building Code (IBC):
  - 1. Section 2304.12 - Wood: Protection Against Decay and Termites.
- F. International Code Council Evaluation Service (ICC-ES).

1.4 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Product Data:
  - 1. Manufacturer's data sheets on each product to be used.
  - 2. Preparation instructions and recommendations.
  - 3. Storage and handling requirements and recommendations.
  - 4. Typical installation methods.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum five years documented experience.



- B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.
- C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- B. Protect from damage due to weather, excessive temperature, and construction operations.

## 1.7 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

## 1.8 WARRANTY

- A. Manufacturer's standard limited warranty unless indicated otherwise.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Allweather Wood, which is located at: 815 S. 32nd St.; Washougal, WA 98671; Toll Free Tel: 800-777-8134; Email: [request info \(jhewitt@mendoco.com\)](mailto:requestinfo@jhewitt@mendoco.com); Web: <https://www.allweatherwood.com>
  - 1. Additional Manufacturing Facilities:
    - a. Allweather Wood, LLC, 715 Denver Ave., Loveland, CO 80537
    - b. Allweather Wood, LLC, 7893 Pacific Ave., White City, OR 97503
    - c. Allweather Wood, LLC, 880 Kunzler Ranch Rd., Ukiah, CA 95482
    - d. Allweather Wood, LLC, 69015 Hauser Depot Rd., North Bend, OR 97459
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00 - Product Requirements.

### 2.2 PRESERVATIVE AND PRESSURE TREATED WOOD LUMBER AND TIMBER

- A. Central Region USA:
  - 1. Plywood:
    - a. Pressure Treatment: Copper Azole Type C (CA-C) CDX Plywood Green Tone.
      - 1) Thickness: 1/2 inches. Size: 4x8 ft.
  - 2. Dimensional Lumber:
    - a. Pressure Treatment: CA-C Douglas-fir. PCF: .15 or .31.
      - 1) Standard and No. 2 Grade or Better Surfaced Four Sides (S4S) and Rough:
        - a) Cross Section: 2x6. Lengths: 8 to 20 ft.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly constructed and prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect in writing of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.

3.4 FIELD QUALITY CONTROL

- A. Field Inspection: Coordinate field inspection in accordance with appropriate sections in Division 01.

3.5 CLEANING AND PROTECTION

- A. Clean products in accordance with the manufacturer's recommendations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

## Section 06 10 00 Rough Carpentry

## PART 1 - GENERAL

## 1.1 DESCRIPTION

- A. This section includes general wood framing, nailers, miscellaneous blocking, laminated veneer lumber and pressure-preservative treated wood.

## 1.2 RELATED WORK

- A. 06 16 00 Sheathing
- B. 06 10 00 Rough Carpentry

## 1.3 REFERENCES AND REGULATORY REQUIREMENTS

- A. Appropriate references included in 01090 References.
- B. State of Michigan Building Code, 2015 Edition.
- C. American Forest & Paper Association, WCD1, "Details for Conventional Wood Frame Construction".
- D. ASTM International.
- E. American Wood Protection Association.
- F. Underwriters Laboratories, Inc (UL) – "Fire Resistance Directory".

## 1.4 SUBMITTAL REQUIREMENTS

- A. All submittals shall be in accordance with 01300 Submittals.
- B. ICC-ES evaluation reports for pressure-preservative treated wood.

## 1.5 QUALITY ASSURANCE

- A. In accordance with 01400 Quality Control.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. All wood products shall be delivered to the site in a clean, dry and undamaged condition.
- B. Store off of the ground and protect from the weather.

## PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Provide dressed lumber, S4S, marked with grade stamp of inspection agency.
- B. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with the State of Michigan 2015 Building Code.
  - 1. Allowable Design Stresses: Engineered wood products shall have allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be demonstrated by comprehensive testing.

## 2.2 TREATED MATERIALS

- A. Preservative-Treated Materials: AWPAC U1; Use Category UC4b for columns and Category UC4a for beams and headers.
  - 1. Use treatment containing no arsenic or chromium.
  - 2. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent.
  - 3. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
- B. Provide preservative-treated materials for all rough carpentry noted below unless otherwise indicated.
  - 1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
  - 2. Wood sills, blocking, furring, and similar concealed members in contact with masonry or concrete.
  - 3. Wood framing members that are less than 18 inches above the ground.
  - 4. Wood floor plates that are installed over concrete slabs-on-grade.
  - 5. Columns.
  - 6. Lacers.
  - 7. Kickers.

## 2.3 FRAMING

- A. Dimension Lumber:
  - 1. Maximum Moisture Content: 19 percent for 2-inch nominal thickness or less, no limit for more than 2-inch nominal thickness.
  - 2. Non-Load-Bearing Interior Partitions: Construction or No. 2, any species.
  - 3. Framing: Douglas Fir No. 1 or Southern Yellow Pine No. 1: NLGA.
  - 4. Exposed Framing: Provide material hand-selected for uniformity of appearance and freedom from characteristics, on exposed surfaces and edges, that would impair finish appearance, including decay, honeycomb, knot-holes, shake, splits, torn grain, and wane.
    - a. Species: As specified for framing other than non-load-bearing interior partitions.
    - b. Grade: Select Structural.

- B. Laminated-Veneer Lumber: Manufactured with exterior-type adhesive complying with ASTM D 2559. Allowable design values determined according to ASTM D 5456.
1. Manufacturers:
    - a. Boise Cascade Corporation.
    - b. Georgia-Pacific.
    - c. Louisiana-Pacific Corporation.
    - d. West Fraser Timber Co., Ltd.
    - e. Weyerhaeuser Company.
  2. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
  3. Modulus of Elasticity, Edgewise: 1,800,000 psi.
  4. Basis of design: Weyerhaeuser Parallam Plus PSL rated for exterior applications.
  5. All Specified Parallam Plus PSL shall be manufactured and labeled as Trus Joist Products by Weyerhaeuser. Genuine Parallam Plus PSL shall be stamped with reference to the treating standards (AWPA U1), third party quality program monitor, preservative retention, and treater.
  6. Modifications/Alternates: The specification is based on Parallam Plus PSL. No alternatives, modifications or substitutions are allowed unless the General Contractor and Sub-Contractors submits in writing for such requests to the Project Engineer for approval, no later than two weeks prior to bid. Alternate products must have design properties equivalent or greater than specified products. Substantiating calculations shall be submitted. All holes, tapered cuts and notching shall be justified for alternate. Contract shall reflect any price changes. The engineer of record shall be reimbursed for any review time.
  7. Preservative-treated wood shall conform to the requirements of the applicable AWPA Standard U1, as adopted per the project's building code.
  8. Preservative-treated beams and headers shall be treated to meet AWPA Use Category UC4A. Preservative-treated columns shall be treated to meet AWPA Use Category UC4B.
  9. Parallam Plus PSL or alternates shall have a minimum 30 year limited warranty against manufacture's defects and termite or fungal decay.
  10. Parallam Plus PSL can be drilled (as approved by the project engineer) or end cut to length without the need to field treat holes or end cuts. Do not rip/resize to custom depths along length of beam. Approved alternative preservative-treated beams shall have surface treatment field applied in accordance with AWPA Standard M4.
  11. Metal hardware or finishes in contact with treated lumber shall conform to manufactures' recommendations.
  12. For Trus Joist Product availability, contact TERRITORY MANAGER NAME & PHONE # or call 1-888-453-8358.

## 2.4 MISCELLANEOUS LUMBER

- A. Miscellaneous Dimension Lumber: Standard, Stud, or No. 2 grade with nineteen percent maximum moisture content of any species. Provide for nailers, blocking, and similar members.

## 2.5 MISCELLANEOUS PRODUCTS

- A. Fasteners: Size and type indicated. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with ASTM A 153/A 153M.
  - 1. Power-Driven Fasteners: CABO NER-272.
  - 2. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- B. Metal Framing Anchors: Structural capacity, type, and size indicated.
  - 1. Manufacturers:
    - a. Cleveland Steel Specialty Co.
    - b. KC Metals Products, Inc.
    - c. Phoenix Metal Products, Inc.
    - d. Simpson Strong-Tie Co., Inc.
    - e. USP Structural Connectors.
  - 2. Use anchors made from galvanized steel.
  - 3. Use anchors made from stainless steel complying with ASTM A 666, Type 304 for exterior locations and where indicated.
- C. Column Anchors
  - 1. Simpson 'Strong-Tie Anchor System'.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Securely attach rough carpentry to substrates, complying with the following:
  - 1. CABO NER-272 for power-driven fasteners.
  - 2. Published requirements of metal framing anchor manufacturer.
  - 3. Table 2304.10.1 "Fastener Schedule" in the 2015 MI Building Code.
- E. Clean up all debris and leave all rough carpentry work in a condition acceptable to other trades.

END OF SECTION

## **TIMBERSTRAND® LSL SPECIFICATIONS**

### **1.0 GENERAL**

#### **1.1 Scope**

This work includes the complete furnishings and installation of all TimberStrand® laminated strand lumber (LSL) as shown on the drawings herein specified and necessary to complete the work.

#### **1.2 Code Approvals**

These products shall be designed and manufactured to the standards set forth in the ICC Evaluation Service, Inc. report ESR-1387.

#### **1.3 Related Work Specified Elsewhere**

**A Carpentry and Millwork**

**B Glu-Laminated Members**

#### **1.4 Design**

##### **A Products**

TimberStrand® LSL shall be designed to fit the dimensions and loads indicated on the plans.

##### **B Design Calculations**

☐ Member calculations shall be prepared by Weyerhaeuser. (Service Fees may apply)

☐ Not required.

#### **1.5 Submittals**

##### **A Drawings**

☐ Manufactures' product cut sheets.

##### **B Production**

Fabrication and/or cutting shall not proceed until the architect and/or engineer have approved the submittal package.

### **2.0 PRODUCTS**

#### **2.1 Materials**

##### **A Code Reports**

Materials shall comply with ICC ES ESR-1387.

##### **B Adhesives**

Adhesives shall be of the waterproof type conforming to the requirements of ASTM D-2559.

#### **2.2 Fabrication**

TimberStrand® LSL shall be manufactured by Weyerhaeuser in a plant listed in the reports referred to above and under the supervision of an approved third-party inspection agency. It shall be manufactured from strands of wood fiber in a continuous process with all strands oriented to the length of the member and then fed into a press. All members are to be free of finger or scarf joints or mechanical connections in full-length members.

## 2.3 Tolerances (dry material)

Tolerances for TimberStrand® LSL are product and application specific.

### A Standard Tolerances

|                                 |   |
|---------------------------------|---|
| Finished length (as specified): | ± 1/8"  |
| Depth:                          | + 1/16", - 0" (Rim Board)<br>± 1/16" (all other products) |
| Width:                          | ± 1/8"  |

### B Millwork and Furniture Frame Tolerances

Tolerances will vary based on manufacturer's requirements.

## 2.4 Identification

TimberStrand® LSL shall be identified by a stamp indicating the product type and grade and ICC ES evaluation report number, manufacturer's name, plant number and the independent inspection agency's logo.

TimberStrand® LSL for use in millwork or furniture frames shall be identified on the product wrapping.

## 2.5 Hardware

Not applicable.

# 3.0 EXECUTION

## 3.1 Installation

TimberStrand® LSL, if stored prior to installation, shall be protected from the weather. It shall be installed in accordance with the plans and any Weyerhaeuser drawings and installation suggestions. Temporary construction loads that cause stresses beyond design limits are not permitted. Safety bracing is to be provided by the installer to keep the TimberStrand® LSL straight and plumb as required and to assure adequate lateral support for the individual TimberStrand® LSL members and the entire system until the sheathing material has been applied.

The contractor may give notification to the manufacturer prior to installation of Trus Joist products to review and discuss product installation guidelines.

## 3.2 Performance Standards

Products shall be proven by testing and evaluation in accordance with the provisions of ASTM D-5456.

## 3.3 Fire Rating

TimberStrand® LSL is permitted to be used in fire-resistive assemblies as a substitute for conventional wood framing. TimberStrand® LSL shall be sized for the same load-carrying capacity as the sawn lumber specified in the assembly, and its dimensions shall be equal to or greater than those specified for the sawn lumber. 1.25" minimum thickness TimberStrand® LSL may also be used in lieu of 2x nominal sawn lumber for fire blocking.

## 3.4 Warranty

The products delivered shall be free from manufacturing errors or defects in workmanship and material. The products, when correctly installed and maintained, shall be warranted to perform as designed for the normal and expected life of the building.

# 4.0 ALTERNATES AND/OR EQUALS

## 4.1 Modifications/Alternates:

Due to the customized detailing and engineering characteristics of the roof, wall and/or floor framing assembly, it is a requirement that TimberStrand LSL be used in the base bid.

The specification is based on Trus Joist engineered wood products. No alternatives, modifications or substitutions are allowed unless the General Contractor and Sub-Contractors submits in writing for such requests to the Project Engineer for approval, no later than two weeks prior to bid. Alternate products must have a current ICC-ES code evaluation report with listed design properties equivalent or greater than specified products. Substantiating calculations shall be submitted. All floor performance, fire endurance, holes, tapered cuts and notching shall be justified for alternate. Contract shall reflect any price changes. The engineer of record shall be reimbursed for any review time.



## SECTION 06 16 00 - SHEATHING

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Roof sheathing.
  - 2. Ceiling panels.

#### 1.02 DELIVERY, STORAGE, AND HANDLING

- A. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

### PART 2 - PRODUCTS

#### 2.01 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWPAC U1; Use Category UC2 for interior construction, Use Category UC3b for exterior construction.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- C. Application: Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing and flashing.

#### 2.02 PLYWOOD ROOF SHEATHING AND CEILING PANELS

- A. Plywood Sheathing: Either DOC PS 1 or DOC PS 2; APA Rated Sheathing; Exposure 1.
  - 1. Performance Category: As needed to comply with requirements specified, but not less than nominal thickness indicated.
  - 2. Span Rating: To suit framing spacing.
  - 3. Factory mark plywood panels to indicate compliance with applicable standard.

#### 2.03 OSB ROOF SHEATHING

- A. OSB Sheathing: DOC PS 2; APA Rated Sheathing; Exposure 1.
  - 1. Performance Category: As needed to comply with requirements specified, but not less than nominal thickness indicated.
  - 2. Span Rating: To suit framing spacing.
  - 3. Factory mark OSB panels to indicate compliance with applicable standard.

#### 2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. For roof sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

## 2.05 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

## PART 3 - EXECUTION

### 3.01 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.
- C. Securely attach to substrate by fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.10.1, "Fastening Schedule," in ICC's "Michigan Building Code."
- D. Coordinate roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Cut and space edges of panels to match spacing of structural support elements.

### 3.02 WOOD STRUCTURAL PANEL INSTALLATION

- A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
  - 1. Apply panels with face grain perpendicular to framing and with ends bearing on framing members.
  - 2. Space panels 1/8 inch apart at edges and ends.
- B. Fastening Methods: Fasten panels as indicated below:
  - 1. Sheathing to Wood Framing: Nail or staple sheathing to framing. Apply a continuous bead of adhesive to framing members at edges of wall sheathing panels.

END OF SECTION 06 16 00

## SECTION 06 17 53 - SHOP-FABRICATED WOOD TRUSSES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section Includes:
  - 1. Wood roof trusses.
  - 2. Wood truss bracing.
  - 3. Metal truss accessories.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For metal-plate connectors, metal truss accessories, and fasteners.
- B. Shop Drawings: Show fabrication and installation details for trusses.
  - 1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
  - 2. Indicate sizes, stress grades, and species of lumber.
  - 3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 4. Indicate locations, sizes, and materials for permanent bracing required to prevent buckling of individual truss members due to design loads.
  - 5. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
  - 6. Show splice details and bearing details.

#### 1.03 INFORMATIONAL SUBMITTALS

- A. Product certificates.
- B. Delegated-Design Submittal: For metal-plate-connected wood trusses indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Evaluation Reports: For the following, from ICC-ES:
  - 1. Metal-plate connectors.
  - 2. Metal truss accessories.

#### 1.04 QUALITY ASSURANCE

- A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
  - 1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
  - 2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
- B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an

independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Handle and store trusses to comply with recommendations in TPI BCSI, "Building Component Safety Information: Guide to Good Practice for Handling, Installing, Restraining, & Bracing Metal Plate Connected Wood Trusses."

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE / DESIGN CRITERIA

- A. Delegated Design: Engage a qualified professional engineer, as defined in Division 01 Section "Quality Requirements," to design metal-plate-connected wood trusses.
- B. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.

#### 2.02 DIMENSION LUMBER

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

#### 2.03 METAL CONNECTOR PLATES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpine Engineered Products, Inc.; an ITW company.
  - 2. Cherokee Metal Products, Inc.; Masengill Machinery Company.
  - 3. CompuTrus, Inc.
  - 4. Eagle Metal Products.
  - 5. Jager Building Systems, Inc.; a Tembec/SGF Rexfor company.
  - 6. MiTek Industries, Inc.; a subsidiary of Berkshire Hathaway Inc.
  - 7. Robbins Engineering, Inc.
  - 8. Truswal Systems Corporation; an ITW company.
  - 9. Comparable products by other manufacturers will be considered.
- B. General: Fabricate connector plates to comply with TPI 1.
- C. Hot-Dip Galvanized-Steel Sheet: ASTM A 653/A 653M; Structural Steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G60 coating designation; and not less than 0.036 inch thick.

## 2.04 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
  - 1. Provide fasteners for use with metal framing anchors that comply with written recommendations of metal framing manufacturer.
- B. Nails, Brads, and Staples: ASTM F 1667.

## 2.05 METAL FRAMING ANCHORS AND ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cleveland Steel Specialty Co.
  - 2. KC Metals Products, Inc.
  - 3. Phoenix Metal Products, Inc.
  - 4. Simpson Strong-Tie Co., Inc.
  - 5. USP Structural Connectors.
  - 6. Comparable products by other manufacturers will be considered.
- B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.
- C. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653/A 653M, G60 coating designation.

## 2.06 FABRICATION

- A. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
  - 1. Fabricate wood trusses within manufacturing tolerances in TPI 1.
- B. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

## PART 3 - EXECUTION

### 3.01 INSTALLATION

- A. Install wood trusses only after supporting construction is in place and is braced and secured.
- B. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.
- C. Install and brace trusses according to TPI recommendations and as indicated.

- D. Anchor trusses securely at bearing points; use metal truss tie-downs. Install fasteners through each fastener hole in metal framing anchors according to manufacturer's fastening schedules and written instructions.
- E. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
  - 1. Install bracing as required.
- F. Install wood trusses within installation tolerances in TPI 1.
- G. Do not alter trusses in field. Do not cut, drill, notch, or remove truss members.
- H. Replace wood trusses that are damaged or do not meet requirements.

END OF SECTION 06 17 53

## SECTION 07 31 13 ASPHALT SHINGLES

### PART 1 - GENERAL

#### 1.1 GENERAL 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. Asphalt shingles.
  - 2. Underlayment.
  - 3. Metal flashing and trim.
- B. Related Requirements:
  - 1. None.

#### 1.3 DEFINITION

- A. Roofing Terminology: See ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" for definitions of terms related to roofing work in this Section.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Not required.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- A. Samples: For each exposed product and for each color and texture specified.
  - 1. Asphalt Shingles: Full size.
- B. Samples for Initial Selection: For each type of asphalt shingle indicated.
  - 1. Include similar Samples of accessories involving color selection.
- C. Samples for Verification: For the following products, of sizes indicated:
  - 1. Asphalt Shingles: Full size.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

- B. Product Test Reports: For each type of asphalt shingle and underlayment product indicated, for tests performed by manufacturer and witnessed by a qualified testing agency or a qualified testing agency.
- C. Evaluation Reports: For synthetic underlayment, from ICC-ES or other testing and inspecting agency acceptable to authorities having jurisdiction, indicating that product is suitable for intended use under applicable building codes.
- D. Sample Warranty: For manufacturer's warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For asphalt shingles to include in maintenance manuals.

#### 1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Asphalt Shingles: 50 sq. ft. of each type, in unbroken bundles.

#### 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

#### 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Store roofing materials in a dry, well-ventilated location protected from weather, sunlight, and moisture according to manufacturer's written instructions.
- B. Store underlayment rolls on end on pallets or other raised surfaces. Do not double stack rolls.
- C. Protect unused roofing materials from weather, sunlight, and moisture when left overnight or when roofing work is not in progress.
- D. Handle, store, and place roofing materials in a manner to prevent damage to roof deck or structural supporting members.
- E. Handle, store and place roofing materials on the roof prior to application in a manner so as to prevent deformation and/or damage to the shingle bundles or shingles.

#### 1.11 FIELD CONDITIONS

- A. Environmental Limitations: Install self-adhering sheet underlayment within the range of ambient and substrate temperatures recommended in writing by manufacturer.



## 1.12 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace asphalt shingles that fail within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Manufacturing defects.
  - 2. Material Warranty Period: 30 years from date of Substantial Completion, prorated, with first three years nonprorated.
  - 3. Wind-Speed Warranty Period: Asphalt shingles will resist blow-off or damage caused by wind speeds of up to 130 mph for five years from date of Substantial Completion.
  - 4. Workmanship Warranty Period: One years from date of Substantial Completion.
- B. Roofing Installer's Warranty: On warranty form at end of this Section, signed by Installer, in which Installer agrees to repair or replace components of asphalt-shingle roofing that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: One years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Exterior Fire-Test Exposure: Provide asphalt shingles and related roofing materials identical to those of assemblies tested for Class A fire resistance according to ASTM E 108 or UL 790 by Underwriters Laboratories or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing agency.

## 2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Three-Tab-Strip Asphalt Shingles: ASTM D 3462/D 3462M, glass-fiber reinforced, mineral-granule surfaced, and self-sealing; with tabs regularly spaced.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; Landmark Premium Series listed on the following link; <http://www.certainteed.com/Pros/Technical-Information> or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
    - c. Other Approved Manufacturer.
  - 2. Strip Size: Manufacturer's standard.
  - 3. Color: To Match Existing

## 2.3 UNDERLAYMENT MATERIALS

- A. Felt: ASTM D 226/D 226M, asphalt-saturated organic felts, nonperforated.
  - 1. Type: Type I.
- B. Glass-Reinforced Felt: ASTM D 6757, glass-reinforced, asphalt-saturated organic felt.

1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; Roofers Select High-Performance Underlayment or comparable product by one of the following:
  - a. GAF Materials Corporation.
  - b. Owens Corning.
- C. Synthetic Underlayment: UV-resistant polypropylene, polyolefin, or polyethylene polymer fabric with surface coatings or treatments to improve traction underfoot and abrasion resistance; evaluated and documented to be suitable for use as a roof underlayment under applicable codes by a testing and inspecting agency acceptable to authorities having jurisdiction.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; DiamondDeck Synthetic High-Performance Underlayment or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
- D. Self-Adhering Sheet Underlayment, Granular Surfaced: ASTM D 1970/D 1970M, minimum of 50-mil- (1.3-mm-) thick sheet; glass-fiber-mat-reinforced, SBS-modified asphalt; mineral-granule surfaced; with release backing; cold applied.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; WinterGuard or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.
- E. Self-Adhering Sheet Underlayment, Polyethylene Faced: ASTM D 1970/D 1970M, minimum of 40-mil- (1.0-mm-) thick, slip-resisting, polyethylene-film-reinforced top surface laminated to SBS-modified asphalt adhesive, with release backing; cold applied.
  1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Corporation; WinterGuard or comparable product by one of the following:
    - a. GAF Materials Corporation.
    - b. Owens Corning.

## 2.4 ACCESSORIES

- A. Asphalt Roofing Cement: ASTM D 4586, Type II, asbestos free.
- B. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.
  1. Shank: Smooth.
  2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.
- C. Felt-Underlayment Nails: Aluminum, stainless-steel, or hot-dip galvanized-steel wire with low-profile capped heads or disc caps, 1-inch (25-mm) minimum diameter.
- D. Synthetic-Underlayment Fasteners Metal or Disc Cap: As recommended in writing by synthetic-underlayment manufacturer for application indicated.

## 2.5 METAL FLASHING AND TRIM

- A. General: Comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
  - 1. Sheet Metal: Anodized aluminum or Aluminum, mill finished.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.
- C.
  - 1. Drip Edges: Fabricate in lengths not exceeding 10 feet with 2-inch roof-deck flange and 1-1/2-inch fascia flange with 3/8-inch drip at lower edge. Match existing profile.
- D. Vent Pipe Flashings: ASTM B 749, Type L51121, at least 1/16 inch thick. Provide lead sleeve sized to slip over and turn down into pipe, soldered to skirt at slope of roof, and extending at least 4 inches from pipe onto roof.

## 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.
  - 1. Examine roof sheathing to verify that sheathing joints are supported by framing and blocking or metal clips and that installation is within flatness tolerances.
  - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and completely anchored; and that provisions have been made for flashings and penetrations through asphalt shingles.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Single-Layer Felt Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides a minimum of 2 inches over underlying course. Lap ends a minimum of 4 inches. Stagger end laps between succeeding courses at least 72 inches. Fasten with felt-underlayment or roofing nails.
  - 1. Install felt underlayment on roof deck not covered by self-adhering sheet underlayment. Lap sides of felt over self-adhering sheet underlayment not less than 3 inches in direction that sheds water. Lap ends of felt not less than 6 inches over self-adhering sheet underlayment.
  - 2. Install fasteners at no more than 36 inches o.c.

3. Install felt underlayment on roof sheathing not covered by self-adhering sheet underlayment. Lap edges over self-adhering sheet underlayment not less than 3 inches in direction that sheds water.
  4. Terminate felt underlayment extended up not less than 4 inches against sidewalls, curbs, chimneys, and other roof projections.
  5. Install fasteners at no more than 36 inch o.c.
- C. Synthetic Underlayment: Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Fasten according to manufacturer's written instructions. Cover underlayment within period recommended in writing by manufacturer.
1. Install in single layer on roofs sloped at 4:12 and greater.
  2. Install in double layer on roofs sloped at less than 4:12.
- D. Self-Adhering Sheet Underlayment: Install, wrinkle free, on roof deck. Comply with low-temperature installation restrictions of underlayment manufacturer if applicable. Install lapped in direction that sheds water. Lap sides not less than 3-1/2 inches. Lap ends not less than 6 inches staggered 24 inches between courses. Roll laps with roller. Cover underlayment within seven days.

### 3.3 METAL FLASHING INSTALLATION

- A. General: Install metal flashings and other sheet metal to comply with requirements in Section 076200 "Sheet Metal Flashing and Trim."
1. Install metal flashings according to recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Rake Drip Edges: Install rake drip-edge flashings over underlayment and fasten to roof deck.
- C. Eave Drip Edges: Install eave drip-edge flashings below underlayment and fasten to roof sheathing.
- D. Pipe Flashings: Form flashing around pipe penetrations and asphalt shingles. Fasten and seal to asphalt shingles as recommended by manufacturer.

### 3.4 ASPHALT-SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip with tabs removed or at least 7 inches wide with self-sealing strip face up at roof edge.
1. Extend asphalt shingles (dimension to match existing) over fasciae at eaves and rakes.
  2. Install starter strip along rake edge.

- A. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern or as specified by the roofing Manufacturer at succeeding courses, maintaining uniform exposure.
- B. Fasten asphalt-shingle strips with a minimum of roofing nails located according to manufacturer's written instructions.

### 3.5 ROOFING INSTALLER'S WARRANTY

- A. WHEREAS <Insert name> of <Insert address>, herein called the "Roofing Installer," has performed roofing and associated work ("the work") on the following project:
  - 1. Owner: <Insert name of Owner>.
  - 2. Address: <Insert address>.
  - 3. Building Name/Type: <Insert information>.
  - 4. Address: <Insert address>.
  - 5. Area of the Work: <Insert information>.
  - 6. Acceptance Date: <Insert date>.
  - 7. Warranty Period: <Insert time>.
  - 8. Expiration Date: <Insert date>.
- B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant the work against leaks and faulty or defective materials and workmanship for designated Warranty Period,
- C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of the work as are necessary to correct faulty and defective work and as are necessary to maintain the work in a watertight condition.
- D. This Warranty is made subject to the following terms and conditions:
  - 1. Specifically excluded from this Warranty are damages to the work and other parts of the building, and to building contents, caused by:
    - a. Lightning;
    - b. Peak gust wind speed exceeding 120 mph;
    - c. Fire;
    - d. Failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
    - e. Faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
    - f. Vapor condensation on bottom of roofing; and
    - g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.
  - 2. When the work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.
  - 3. Roofing Installer is responsible for damage to the work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of the work.

4. During Warranty Period, if Owner allows alteration of the work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of the alterations, but only to the extent the alterations affect the work covered by this Warranty. If Owner engages Roofing Installer to perform the alterations, Warranty shall not become null and void unless Roofing Installer, before starting the alterations, notified Owner in writing, showing reasonable cause for claim, that the alterations would likely damage or deteriorate the work, thereby reasonably justifying a limitation or termination of this Warranty.
  5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a use or service more severe than originally specified, this Warranty shall become null and void on date of the change, but only to the extent the change affects the work covered by this Warranty.
  6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect the work and to examine evidence of such leaks, defects, or deterioration.
  7. This Warranty is recognized to be the only warranty of Roofing Installer on the work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of the work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner's General Contractor.
- E. IN WITNESS THEREOF, this instrument has been duly executed this **<Insert day>** day of **<Insert month>**, **<Insert year>**.
1. Authorized Signature: **<Insert signature>**.
  2. Name: **<Insert name>**.
  3. Title: **<Insert title>**.

END OF SECTION 073113

## SECTION 07 46 00 VINYL SIDING

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Solid vinyl siding.
- B. Solid vinyl soffit.
- C. Vinyl trim.

#### 1.2 RELATED SECTIONS

- A. Section 06 10 00 - Rough Carpentry

#### 1.3 REFERENCES

- A. ASTM D 256 - Standard Test Method for Determining the Pendulum Impact Resistance of Notched Specimens of Plastics.
- B. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
- C. ASTM D 638 - Standard Test Method for Tensile Properties of Plastics.
- D. ASTM D 648 - Standard Test Method for Deflection Temperature of Plastics Under Flexural Load.
- E. ASTM D 696 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30 Degrees C. and 30 Degrees C.
- F. ASTM D 1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
- G. ASTM D 2843 - Standard Test Method for Density of Smoke from the Burning or Decomposition of Plastics.
- H. ASTM D 3679 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Siding.
- I. ASTM D 4477 - Standard Specification for Rigid Unplasticized Poly(Vinyl Chloride) (PVC) Soffit.
- J. ASTM D 6864 - Standard Specification for Color and Appearance Retention of Solid Colored Plastic Siding Products.
- K. ASTM D7251 - Standard Specification for Color and Appearance Retention of Variegated Color Plastic Siding Products
- L. ASTM D 7856 - Standard Specification for Color and Appearance Retention of Solid and Variegated Color Plastic Siding Products using CIELab Color Space.
- M. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

- N. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2000.
- O. UBC STD 26-9 - Method of Test for the Evaluation of Flammability Characteristics of Exterior, Nonload-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus; 1997.

#### 1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Code compliance in accordance with the following:
  - 1. Metropolitan Dade County, Florida.
  - 2. ICC Evaluation Service.
  - 3. State of Florida.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
  - 4. Maintenance and care requirements.
- C. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Provide installer with not less than three years of experience with products specified.
- B. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
  - 1. Finish areas designated by Architect.
  - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
  - 3. Refinish mock-up area as required to produce acceptable work.
  - 4. Accepted mock-ups shall be comparison standard for remaining work.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store on a flat surface under cover, stacked no more than 12 boxes high. Do not store in location where temperatures may exceed 130 degrees F.

#### 1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute



limits.

## 1.9 WARRANTY

- A. Provide manufacturer's standard limited lifetime warranty.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Ply Gem Industries, Inc., 2600 Grand Blvd., Suite 900, Kansas City, MO 64108. ASD. Telephone Toll Free: (800) 962-6973 or (800) 788-1964. Fax: (866) 656-1900, Website: [www.gpvynilsiding.com](http://www.gpvynilsiding.com). Email: [support@mastichomesinfo.com](mailto:support@mastichomesinfo.com).
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### 2.2 MATERIALS

- A. Siding and Soffit - General Requirements: Polyvinyl chloride products with the following characteristics:
  - 1. Siding: Comply with ASTM D 3679, Class 2.
  - 2. PVC cell classification in accordance with ASTM D 1784: 13334.
  - 3. Coefficient of linear expansion in accordance with ASTM D 696: 0.000029 inch per inch per degree F.
  - 4. Tensile strength when tested in accordance with ASTM D 638: Minimum 6,326 pounds per square inch.
  - 5. Modulus of elasticity when tested in accordance with ASTM D 638: Minimum 360,000 pounds per square inch, average.
  - 6. Izod impact, standard 1/8 inch bar when tested in accordance with ASTM D 256: 3.30 foot-pounds per inch, average.
  - 7. Shore D Hardness: Minimum 82.
  - 8. Specific Gravity: Minimum 1.39.
  - 9. Deflection temperature when tested in accordance with ASTM D 648: 170 degrees F, 264 pounds per square inch.
  - 10. Smoke density rating when tested in accordance with ASTM D 2843: 48 percent, average.
  - 11. Horizontal flammability, when tested in accordance with ASTM D 635:
    - a. Burn distance: 20 mm.
    - b. Burn time: Less than 5 seconds.
  - 12. Surface burning characteristics when tested in accordance with ASTM E 84: Flame spread less than 20, fuel contribution 0, smoke density 275.
  - 13. Fire Resistance - Siding: 1 hour, when tested in accordance with ASTM E 119, with siding applied over gypsum sheathing.
  - 14. Flammability - Siding: Comply with requirements of UBC Std 26-9.
  - 15. Caliber Double 6 inch, foamed backed siding with EPS foam backing has a Permeability Rating of 5.
- B. Fasteners: Aluminum nails, alloy 5056 or 6110, having minimum tensile strength 63,000 pounds per square inch.
- C. Vapor Retarder: Specified in Section 07 26 00.

- D. Joint Sealers: Specified in Section 07 90 00.

## 2.3 VINYL SIDING AND TRIM

- A. Mastic Eclipse Vinyl Siding:
  - 1. Product Description: Double 4 Traditional
    - a. Color: As selected from manufacturer's full range of standard colors.
    - b. VSI Certified Insulated siding with Color Retention: Meets or exceeds requirements of ASTM D 7856, ASTM D 6864, and ASTM D 7251.

## 2.4 VINYL SOFFIT AND TRIM

- A. Vinyl T/4 Soffit: Use with 1/2 inch installation accessories.
  - 1. Product Description: Triple 4 inch Solid Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length.
  - 2. Product Description: Triple 4 inch Full-Vent Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length. Basketweave Venting, with Net Free Air Space of 14.34 sq. inches / square foot.
  - 3. Product Description: Triple 4 inch Center Vent Soffit with pebble finish, nominal 0.035 inch material thickness; nominal 12 feet piece length. Basketweave Venting, with Net Free Air Space of 4.78 sq. inches / square foot.
  - 4. Nailing Hem: Single-row, with elongated nailing holes 1-1/4 inches long at 1- 5/8 inches on center.
  - 5. Color: As selected from manufacturer's full range of standard colors.
  - 6. VSI Certified Vinyl siding with Color Retention: Meets or exceeds requirements of ASTM D 7856, ASTM D 6864, and ASTM D 7251.
- B. Vinyl Trim:
  - 1. Soffit J-Trim 1/2 inch: Channel, 1-1/2 inches nailing leg, 3/4 inch forward leg, 1/2 inch channel width; \_\_\_\_\_color. Length 12 foot 6 inches.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared. Verify dimensions and acceptability of substrate
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Installation of vapor retarder is specified in Section 07 26 00
- C. Attach vinyl products to substrate for weathertight installation; ensure that horizontal components are installed true to level, that vertical components are installed true to plumb.
- D. Stagger lap joints in horizontal siding in uniform pattern as successive courses of siding are installed.
- E. Install joint sealers as specified in Section 07900.

### 3.4 ADJUSTING AND CLEANING

- A. Clean dirt from surface of installed products, using mild soap and water.
- B. After completing installation, remove from project site excess materials and debris resulting from installation of vinyl products.

### 3.5 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF

## SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes hollow-metal work.

#### 1.02 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings according to NAAMM-HMMA 803 or SDI A250.8.

#### 1.03 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld International, LLC.
  - 2. Ceco Door Products; an Assa Abloy Group company.
  - 3. Curries Company; an Assa Abloy Group company.
  - 4. Karpen Steel Custom Doors & Frames.
  - 5. Mesker Door Inc.
  - 6. Republic Doors and Frames.
  - 7. Steelcraft; an Ingersoll-Rand company.

#### 2.02 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

- A. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3..
  - 1. Physical Performance: Level A according to SDI A250.4.
  - 2. Doors:
    - a. Type: As indicated in the Door and Frame Schedule.
    - b. Thickness: 1-3/4 inches.
    - c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
    - d. Edge Construction: Model 2, Seamless.
    - e. Core: Polyurethane.
  - 3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.
  - 4. Frames:
    - a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.

- b. Construction: Full profile welded.
- 5. Exposed Finish: Prime.

## 2.03 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.04 MATERIALS

- A. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- B. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- D. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- F. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat.

## 2.05 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Doors:
  - 1. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
- C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  - 1. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

2. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  3. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Three anchors per jamb from 60 to 90 inches high.
  4. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
    - a. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.06 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: SDI A250.10.

## 2.07 ACCESSORIES

- A. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Install door silencers in frames before grouting.
    - b. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - c. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - d. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

4. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.
  1. Non-Fire-Rated Steel Doors:
    - a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
    - c. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.
    - d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

### 3.02 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- D. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

END OF SECTION 08 11 13

## SECTION 08 36 00 SECTIONAL OVERHEAD DOORS

### PART 1 GENERAL

#### 1.1 SECTION INCLUDES

- A. Insulated Sectional Overhead Doors.
- B. Electric Operators and Controls.
- C. Operating Hardware, tracks, and support.

#### 1.2 RELATED SECTIONS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 04 22 00 - Concrete Masonry Unit.
- C. Section 05 50 00 - Metal Fabrications.
- D. Section 06 10 00 – Rough Carpentry.

#### 1.3 REFERENCES

- A. ANSI/DASMA 102 - American National Standard Specifications for Sectional Overhead Type Doors.

#### 1.4 DESIGN / PERFORMANCE REQUIREMENTS

- A. Single-Source Responsibility: Provide doors, tracks, motors, and accessories from one manufacturer for each type of door. Provide secondary components from source acceptable to manufacturer of primary components.

#### 1.5 SUBMITTALS

- A. Submit under provisions of Section 01 30 00.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- C. Shop Drawings: Indicate plans and elevations including opening dimensions and required tolerances, connection details, anchorage spacing, hardware locations, and installation details.
- D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.
- E. Operation and Maintenance Data.

#### 1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Authorized representative of the manufacturer with minimum five years documented experience.



- C. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories, Inc. acceptable to authority having jurisdiction as suitable for purpose specified.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened labeled packaging until ready for installation.
- B. Protect materials from exposure to moisture until ready for installation.
- C. Store materials in a dry, ventilated weathertight location.

## 1.8 PROJECT CONDITIONS

- A. Pre-Installation Conference: Convene a pre-installation conference just prior to commencement of field operations, to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work.

## 1.9 WARRANTY

- A. Warranty: Manufacturer's limited door and operators System warranty for 10 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.
- B. Warranty: Manufacturer's limited door and operators System warranty for 8 year against delamination of polyurethane foam from steel face and all other components for 3 years or 20,000 cycles, whichever comes first.
- C. Warranty: Manufacturer's limited door and operators System warranty for 10 years against delamination of polystyrene foam from steel face.

## PART 2 PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturer: Overhead Door Corporation, which is located at: 2501 S. State Hwy. 121 Suite 200; Lewisville, TX 75067; Toll Free Tel: 800-275-3290; Tel: 469-549-7100; Fax: 972-906-1499; Email: [request info \(info@overheaddoor.com\)](mailto:info@overheaddoor.com); Web: <https://www.overheaddoor.com>
- B. Requests for substitutions will be considered in accordance with provisions of Section 01 60 00.

### 2.2 INSULATED SECTIONAL OVERHEAD DOORS

- A. Insulated Steel Sectional Overhead Doors: 470 Series Insulated Steel Doors by Overhead Door Corporation. Units shall have the following characteristics:
  - 1. Door Assembly: Rigid steel construction; fully insulated on the inside face with continuous steel backing on the inside face. Fabricated with steel end stiles and tongue and groove sections.
    - a. Panel Thickness: 2 inches (51 mm).
    - b. Exterior Surface: Ribbed.
    - c. Exterior Steel: 26 gauge, hot-dipped galvanized with an embossed simulated wood grain texture.
    - d. Interior Steel: 29 gauge, hot-dipped galvanized
    - e. Springs:
      - 1) 10,000 cycles.

- 2) 25,000 cycles.
    - 3) 50,000 cycles.
    - 4) 75,000 cycles.
    - 5) 100,000 cycles.
  - f. Insulation: Polystyrene.
  - g. Thermal Values:
    - 1) Polystyrene - R-value of 9.83; U-value of 0.102.
  - h. Partial Glazing of Steel Panels:
    - 1) 19 inch by 12 inch window.
      - a) DSB
      - b) Tempered Glass
      - c) Clear Lexan
      - d) Solar Bronze
      - e) Obscure
    - 2) 42 inch by 13 inch window.
      - a) DSB
- 2. Finish and Color: Two coat baked-on polyester. Color as follows:
  - a. White
- 3. Windload Design: Provide to meet the Design/Performance requirements specified.
- 4. Hardware: Galvanized steel hinges and fixtures. Ball bearing rollers with hardened steel races.
- 5. Lock:
  - a. Interior mounted slide lock.
- 6. Weatherstripping:
  - a. Flexible bulb-type strip at bottom section.
  - b. Flexible Jamb seals.
  - c. Flexible Header seal.
- 7. Track: Provide track as recommended by manufacturer to suit loading required and clearances available.
- 8. Electric Motor Operation: Provide UL listed electric operator, size and type as recommended by manufacturer to move door in either direction at not less than 2/3 foot nor more than 1 foot per second. Operator shall meet UL325/2010 requirements for continuous monitoring of safety devices.
  - a. Entrapment Protection: Required for momentary contact, includes radio control operation.
    - 1) Pneumatic sensing edge up to 18 feet (5.5 m) wide. Constant contact only complying with UL 325/2010.
    - 2) Electric sensing edge monitored to meet UL 325/2010.
    - 3) Photoelectric sensors monitored to meet UL 325/2010.
  - b. Operator Controls:
    - 1) Push-button operated control stations with open, close, and stop buttons.
    - 2) Surface mounting.
    - 3) Interior location.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not begin installation until openings have been properly prepared.
- B. Verify wall openings are ready to receive work and opening dimensions and tolerances are within specified limits.
- C. Verify electric power is available and of correct characteristics.

- D. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### 3.2 PREPARATION

- A. Clean adjacent surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

### 3.3 INSTALLATION

- A. Install overhead doors and track in accordance with approved shop drawings and the manufacturer's printed instructions.
- B. Coordinate installation with adjacent work to ensure proper clearances and allow for maintenance.
- C. Anchor assembly to wall construction and building framing without distortion or stress.
- D. Securely brace door tracks suspended from structure. Secure tracks to structural members only.
- E. Fit and align door assembly including hardware.
- F. Coordinate installation of electrical service. Complete power and control wiring from disconnect to unit components.

### 3.4 CLEANING AND ADJUSTING

- A. Adjust door assembly to smooth operation and in full contact with weatherstripping.
- B. Clean doors, frames, glass and polycarbonate according to manufacturer's instructions.
- C. Remove temporary labels and visible markings. Do not remove polycarbonate care and maintenance label required to maintain warranty.

### 3.5 PROTECTION

- A. Do not permit construction traffic through overhead door openings after adjustment and cleaning.
- B. Protect installed products until completion of project.
- C. Touch-up, damaged coatings and finishes and repair minor damage before Substantial Completion.

END OF SECTION

## SECTION 08 71 00 - DOOR HARDWARE

### PART 1 - GENERAL

#### 1.01 SUMMARY

- A. Section includes:
  - 1. Mechanical door hardware for swinging doors.

#### 1.02 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each type and finish of exposed hardware for verification.
  - 1. Tag Samples with full description for coordination with the door hardware schedule.
  - 2. Submit Samples before or concurrent with submission of door hardware schedule.
- C. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
  - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.

#### 1.03 DELIVERY, STORAGE, AND HANDLING

- A. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE CRITERIA

- A. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

#### 2.02 SCHEDULED DOOR HARDWARE

- A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.
  - 1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated and complying with BHMA designations referenced. Provide named products or products of other manufacturers equivalent in function and comparable in quality to named products.
    - a. Designations: Requirements for quantity, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article.

- b. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.
- c. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

## 2.03 HINGES

- A. Hinges: BHMA A156.1.
  - 1. Manufacturers:
    - a. Baldwin Hardware Corporation.
    - b. Bommer Industries, Inc.
    - c. Cal-Royal Products, Inc.
    - d. Hager Companies.
    - e. IVES Hardware; an Ingersoll-Rand company.
    - f. Lawrence Hardware Inc.
    - g. McKinney Products Company; an ASSA ABLOY Group company.
    - h. PBB, Inc.
    - i. Stanley Commercial Hardware; Div. of The Stanley Works.
    - j. Comparable products by other manufacturers will be considered.

## 2.04 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
- C. Lock Backset: 2-3/4 inches, unless otherwise indicated.
- D. Lock Trim:
  - 1. Description: As scheduled.
  - 2. Levers: Wrought.
  - 3. Escutcheons (Roses): Wrought.
- E. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
  - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- F. Bored Locks: BHMA A156.2; Grade 2; Series 4000.
  - 1. Manufacturers:
    - a. Arrow USA; an ASSA ABLOY Group company.
    - b. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    - c. Cal-Royal Products, Inc.
    - d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.
    - e. Falcon Lock; An Ingersoll-Rand Company.
    - f. K2 Commercial Hardware; a Black & Decker Corp. company.
    - g. Marks USA.
    - h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.

- i. PDQ Manufacturing.
- j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
- k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
- l. Weiser Lock Corp.; a Black & Decker Corp. company.
- m. Yale Security Inc.; an ASSA ABLOY Group company.
- n. Comparable products by other manufacturers will be considered.

## 2.05 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference.
  - 1. Existing System:
    - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver or brass.

## 2.06 ACCESSORIES FOR PAIRS OF DOORS

- A. None

## 2.07 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders: BHMA A156.8.
  - 1. Manufacturers:
    - a. Architectural Builders Hardware Mfg., Inc.
    - b. Glynn-Johnson; an Ingersoll-Rand company.
    - c. Rockwood Manufacturing Company.
    - d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    - e. Comparable products by other manufacturers will be considered.

## 2.08 DOOR GASKETING

- A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
  - 1. Manufacturers:
    - a. Hager Companies.
    - b. M-D Building Products, Inc.
    - c. National Guard Products.
    - d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
    - e. Reese Enterprises, Inc.
    - f. Sealeze; a unit of Jason Incorporated.
    - g. Zero International.
    - h. Comparable products by other manufacturers will be considered.

## 2.09 THRESHOLDS

- A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.
  - 1. Manufacturers:
    - a. Hager Companies.

- b. M-D Building Products, Inc.
- c. National Guard Products.
- d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
- e. Reese Enterprises, Inc.
- f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
- g. Sealeze; a unit of Jason Incorporated.
- h. Zero International.
- i. Comparable products by other manufacturers will be considered.

## 2.10 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except as approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.
- C. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

## 2.11 FINISHES

- A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Generally, Satin Chrome, US26D:
  - 1. Aluminum Thresholds: Mill Finish.
- E. Aluminum Astragals, Stop Seals, Automatic Door Bottoms, Bottom Seals, and Weather-stripping: Satin Aluminum, Clear Anodized, US28.

## PART 3 - EXECUTION

### 3.01 EXAMINATION AND PREPARATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance.
- B. Do not install surface-mounted items until finishes have been completed on substrates involved.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Field Door Preparation to Receive Hardware:
  - 1. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

### 3.02 INSTALLATION

- A. Comply with manufacturer's written installation instructions and recommendations and approved submittals.
  - 1. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing.
  - 2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  - 3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- B. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: Per DHI "Recommended Locations for Architectural Hardware for Standard Steel Doors & Frames."
- C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Thresholds: Set thresholds for exterior doors in full bed of butyl sealant.
- E. Gasketing: Apply to head and jamb perimeter, forming seal between door and frame.

### 3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

### 3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.



- B. Clean operating items as necessary to restore proper function and finish.

3.05 PROTECTION

- A. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.06 SCHEDULE

- A. See construction drawings sheet A-3

END OF SECTION 08 71 00

## SECTION 220500 – COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Equipment installation requirements common to equipment sections.
9. Painting and finishing.
10. Supports and anchorages.
11. Mechanical Identification
12. Pipe curbs and equipment supports.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

C. Operation and Maintenance Data: At the end of the project the contractor shall submit two paper copies of the Operation and Maintenance Data to the owner in three ring binders with the project title and contractor's contact information.

D. Project Record Documents: Throughout the project the contractor shall keep a running record of as-builts showing deviations from the plans. At the end of the project the contractor shall submit one clean hand sketch set of documents to the owner.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Drawings are diagrammatical and do not necessarily show all fittings required to meet field conditions and coordination requirements with other trades. The contractor is responsible for making adjustments in the routing and elevations to meet the job requirements and maintaining required slopes as required for each system.

# PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
1. ABS Piping: ASTM D 2235.
  2. CPVC Piping: ASTM F 493.
  3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  4. Aboveground Pressure Piping: Pipe fitting.

- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.

- f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150 or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150 or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:

- a. Advance Products & Systems, Inc.
  - b. Calpico, Inc.
  - c. Metraflex Co.
  - d. Pipeline Seal and Insulator, Inc.
2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.



1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.

- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
    - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated or rough-brass finish.
    - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
    - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Permanent sleeves are not required for holes formed by removable PE sleeves.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. PVC or Steel Pipe Sleeves: For pipes smaller than NPS 6 (DN 150).

- b. Steel Sheet Sleeves: For pipes NPS 6 (DN 150) and larger, penetrating gypsum-board partitions.
  - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
    - 1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- P. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Section "Through-Penetration Firestop Systems" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- 3.2 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
  - B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
  - D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
  - E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Install equipment per the manufacturer's recommendations. If the manufacturer's recommendations are different than shown on the construction documents or as otherwise specified contact the engineer.
- F. Contractor shall provide all equipment and associated controls required to provide a complete and operable system.

- G. The scope of work for all Division 22 sections includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.

### 3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Architectural Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

END OF SECTION 220500

## SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following general-duty valves:
  - 1. Copper-alloy ball valves.
  - 2. Gate valves.
- B. See other Sections for general-duty and specialty valves for site construction piping.

#### 1.2 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; furnished specialties; and accessories.

#### 1.3 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 and 372 for valve materials for potable-water service.
- D. ANSI Compliance: ANSI 372
- E. Senate Bills 3874: All valves 2 inches and smaller shall be lead free with lead content less than 0.25%.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: NPS 2 and Smaller: Threaded ends, unless otherwise indicated.
- C. Brass Valves: NPS 2 and Smaller: Victaulic VIP Press 304™ ends, unless otherwise indicated
- D. Ferrous Valves NPS 2-1/2 and Larger: Grooved or flanged ends, unless otherwise indicated.
- E. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- G. Valve Actuators:
  - 1. Handwheel: For valves other than quarter-turn types.
  - 2. Lever Handle: For quarter-turn valves NPS 6 and smaller, except plug valves.
- H. Extended Valve Stems: On insulated valves.
- I. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- J. Valve Grooved Ends: ASME/AWWA C606.
  - 1. Solder Joint: With sockets according to ASME B16.18.
    - a. Caution: Use solder with melting point below 840 deg F for check, gate, and globe valves; below 421 deg F for ball valves.
  - 2. Threaded: With threads according to ASME B1.20.1.
- K. Valve Bypass and Drain Connections: MSS SP-45.

## 2.3 COPPER-ALLOY BALL VALVES

- A. Manufacturers:
  - 1. One-Piece, Copper-Alloy Ball Valves:
    - a. Conbraco Industries, Inc.; Apollo Div.
    - b. Jenkins Valves.
    - c. Stockham Valves.
    - d. Grinnell Corporation.
    - e. Jamesbury, Inc.
    - f. NIBCO INC.
    - g. Watts Industries, Inc.; Water Products Div.
  - 2. Two-Piece, Copper-Alloy Ball Valves:

- a. Conbraco Industries, Inc.; Apollo Div.
- b. Crane Valves.
- c. Jenkins Valves.
- d. Stockham Valves.
- e. Grinnell Corporation.
- f. Hammond Valve.
- g. Jamesbury, Inc.
- h. Milwaukee Valve Company.
- i. NIBCO INC.
- j. Victaulic Company of America
- k. Watts Industries, Inc.; Water Products Div.

B. Plumbing

1. Ball Valves – 2” and Smaller (Alternate to standard port): Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, full port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.
2. Ball Valves – 3” and Smaller: Ball valves shall be 300 or 600# WOG, 150# SWP, 2 piece body style, STD port, CP solid brass tunneled ball, reinforced Teflon seats, hex gland follower, bronze body of ASTM B584, blowout proof stem, lever handle.

2.4 GATE VALVES

A. Manufacturers:

1. Gate Valves:
  - a. Cincinnati Valve Co.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Crane Co.; Crane Valve Group; Jenkins Valves.
  - d. Crane Co.; Crane Valve Group; Stockham Div.
  - e. Grinnell Corporation.
  - f. Hammond Valve.
  - g. Milwaukee Valve Company.
  - h. NIBCO INC.
  - i. Powell, Wm. Co.
  - j. Watts Industries, Inc.; Water Products Div.

B. Plumbing

1. Gate Valves – Up To 2 ½”: Gate valves shall be class 125# SWP, 200# WOG, rising stem, threaded bonnet, solid wedge, malleable iron handwheel, body and bonnet shall be of ASTM B62 bronze, non-asbestos packing, MSS SP-80.
2. Gate Valves – 3” and larger: Gate valves shall be class 125# SWP, 200# WOG, rising stem, OS&Y, bolted bonnet, body and bonnet shall be of ASTM A126 Class B cast iron, flange ends, bronze trim, non-asbestos packing, MSS SP-70.



## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, or gate valves.
  - 2. Throttling Service: Ball, butterfly, or globe valves.
  - 3. Pump Discharge: Spring-loaded, lift-disc check valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

### 3.2 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.
- F. Provide stem extensions for ball valves being installed on insulated lines.
- G. Provide memory stops for all valves to be used for balancing.
- H. Install butterfly valves with stem at the horizontal, and so that the handle points down when closed, and in the direction of flow when in the open position.
- I. Adjust all packing nuts after installation.
- J. Provide lever handles for 6" and smaller butterfly valves.
- K. Provide gear operator for 8" and larger butterfly valves.
- L. Provide chain wheel operator when above 7 feet.

### 3.3 JOINT CONSTRUCTION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.
- B. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.4 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 220523

## SECTION 220529 – HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. See Division 22 Section "Mechanical Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation supports and hangers and seismic restraints.

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 MANUFACTURED UNITS

### A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components.

#### 1. Manufacturers:

- a. AAA Technology and Specialties Co., Inc.
- b. B-Line Systems, Inc.
- c. Carpenter & Patterson, Inc.
- d. Empire Tool & Manufacturing Co., Inc.
- e. Globe Pipe Hanger Products, Inc.
- f. Anvil International.
- g. GS Metals Corp.
- h. Michigan Hanger Co., Inc.
- i. National Pipe Hanger Corp.
- j. PHD Manufacturing, Inc.
- k. PHS Industries, Inc.
- l. Piping Technology & Products, Inc.

2. Galvanized, Metallic Coatings: For piping and equipment that will not have field-applied finish.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

### B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

#### 1. Manufacturers:

- a. B-Line Systems, Inc.
- b. Anvil International.
- c. GS Metals Corp.
- d. Michigan Hanger Co., Inc.
- e. National Pipe Hanger Corp.
- f. Thomas & Betts Corp.
- g. Unistrut Corp.
- h. Wesanco, Inc.

2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

### C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.

#### 1. Manufacturers:

- a. Carpenter & Patterson, Inc.
- b. Michigan Hanger Co., Inc.
- c. PHS Industries, Inc.
- d. Pipe Shields, Inc.
- e. Rilco Manufacturing Co., Inc.

## f. Value Engineered Products, Inc.

2. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
3. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
6. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Hanger Rods: Galvanized all-thread, ASTM A 36.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

## 3.1 APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.
- C. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification 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 120 to 450 deg F pipes, NPS 4 to NPS 16 , 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 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Adjustable Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  5. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.

6. 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.
  7. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  8. 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.
- D. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- E. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
- F. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. 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.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- G. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- H. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

### 3.2 INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- E. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- 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. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- J. Insulated Piping: Comply with the following:
  - 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 according to ASME B31.9.
  - 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.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
  - 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 inserts.
  - 6. Insert Material: Length at least as long as protective shield.
  - 7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor. Place grout under supports for equipment and make smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching Up: 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 220529

## SECTION 220553 – IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:

1. Equipment nameplates.
2. Equipment markers.
3. Equipment signs.
4. Pipe markers.
5. Stencils.
6. Valve tags.
7. Warning tags.

#### 1.3 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### 1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
  - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  - 3. Thickness: 1/8 inch, unless otherwise indicated.
  - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### 2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
  - 1. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length

3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
  4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
  5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.
- D. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, and 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.

## 2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs and similar operational instructions.
1. Stencil Material: Metal or fiberboard
  2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
1. Material: 0.032-inch-thick brass or aluminum.
  2. Material: 3/32-inch-thick laminated plastic with 2 black surfaces and white inner layer.
  3. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

## 2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 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. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 22 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

### 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
  - 1. Pumps, compressors and similar motor-driven units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
  - 1. Letter Size: Minimum 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.
  - 2. Data: Distinguish among multiple units,
  - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Pumps, compressors and similar motor-driven units.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
  - 1. Identify mechanical equipment with equipment markers in the following color codes:
    - a. **[Yellow]**: For heating equipment and components.
  - 2. Letter Size: Minimum 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.
  - 3. Data: Distinguish among multiple units, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Include signs for the following general categories of equipment:
  - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  - 2. Pumps, compressors and similar motor-driven units.
- F. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- G. Install access panel markers with screws on equipment access panels.

### 3.3 PIPING IDENTIFICATION

- A. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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 markers.

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; 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.

### 3.5 VALVE-SCHEDULE INSTALLATION

- A. Mount valve schedule on wall in accessible location in each major equipment room.

### 3.6 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Provide warning tags on equipment and with wording as directed by the Architect.

### 3.7 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### 3.8 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 220553

## SECTION 230500 – COMMON WORK RESULTS FOR HVAC

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Transition fittings.
  - 2. Mechanical sleeve seals.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Grout.
  - 6. Equipment installation requirements common to equipment sections.
  - 7. Painting and finishing.
  - 8. Supports and anchorages.
  - 9. Mechanical Identification

## 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.



G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Mechanical sleeve seals.

B. Welding certificates.

C. Operation and Maintenance Data: At the end of the project the contractor shall submit two paper copies of the Operation and Maintenance Data to the owner in three ring binders with the project title and contractor's contact information.

D. Project Record Documents: Throughout the project the contractor shall keep a running record of as-builts showing deviations from the plans. At the end of the project the contractor shall submit one clean hand sketch set of documents to the owner.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

D. Install all equipment, materials, and accessories per manufacturers written instructions.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8-inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. ABS Piping: ASTM D 2235.
  - 2. CPVC Piping: ASTM F 493.
  - 3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
  - 4. PVC to ABS Piping Transition: ASTM D 3138.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

## 2.3 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Plastic, Carbon steel or Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating or Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.4 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.5 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated and rough brass.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed or exposed-rivet hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.6 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

## 2.7 MECHANICAL IDENTIFICATION

- A. Duct Labels:
  - 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: Black

3. Background Color: White
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-quarters the size of principal lettering.
7. Fasteners: Stainless-steel rivets.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
9. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings; also include duct size and an arrow indicating flow direction.
10. 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.

B. Stencils:

1. Stencils for Ducts:
  - a. Lettering Size: Minimum letter height of 1-1/4 inches for viewing distances up to 15 feet and proportionately larger lettering for greater viewing distances.
  - b. Stencil Material: Aluminum
  - c. Stencil Paint: Exterior, gloss, alkyd enamel Paint may be in pressurized spray-can form.
  - d. Identification Paint: Exterior, alkyd enamel. Paint may be in pressurized spray-can form.

### PART 3 - EXECUTION

#### 3.1 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Install equipment per the manufacturer's recommendations. If the manufacturer's recommendations are different than shown on the construction documents or as otherwise specified contact the engineer.

- F. Contractor shall provide all equipment and associated controls required to provide a complete and operable system.
- G. The scope of work for all Division 23 sections includes all miscellaneous work needed (whether or not specified or shown on the documents) to produce a complete and fully operational system.

### 3.2 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Architectural Section.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### 3.5 GROUTING

- A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

### 3.6 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### 3.7 DUCT LABEL INSTALLATION

- A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  - 1. Blue: For outside air ducts.
  - 2. Orange: For exhaust ducts.
- B. Stenciled Duct Label Option: Stenciled labels showing service and flow direction may be provided instead of plastic-laminated duct labels, at Installer's option.
- C. Locate labels near points where ducts enter into and exit from concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

### 3.8 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.

### 3.9 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 230500

## SECTION 230529 – HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes hangers and supports for mechanical system piping and equipment.
- B. See Division 21 Sections on fire-suppression piping for fire-suppression piping hangers and supports.
- C. See Division 23 Section "Mechanical Vibration and Seismic Controls for HVAC Piping and Equipment" for vibration isolation supports and hangers and seismic restraints.

#### 1.2 DEFINITIONS

- A. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.

#### 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:



1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

## 2.2 MANUFACTURED UNITS

- A. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.

1. Manufacturers:
  - a. B-Line Systems, Inc.
  - b. Grinnell Corp.
  - c. GS Metals Corp.
  - d. Michigan Hanger Co., Inc.
  - e. National Pipe Hanger Corp.
  - f. Thomas & Betts Corp.
  - g. Unistrut Corp.
  - h. Wesanco, Inc.
2. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
3. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.

## 2.3 MISCELLANEOUS MATERIALS

- A. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- C. Hanger Rods: Galvanized all-thread, ASTM A 36.
- D. Grout: ASTM C 1107, Grade B, factory-mixed and -packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
  1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
  2. Properties: Nonstaining, noncorrosive, and nongaseous.
  3. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Specific hanger requirements are specified in Sections specifying equipment and systems.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Specification Sections.

- C. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification 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.
- D. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification 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. 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.
  8. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  9. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- E. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification 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 by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- F. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  2. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  3. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

### 3.2 INSTALLATION

- A. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems. Field assemble and install according to manufacturer's written instructions.
- B. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes. Support pipes of various sizes together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, 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.
- D. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- F. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- G. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure above or to support equipment above floor. Place grout under supports for equipment and make smooth bearing surface.

### 3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for heavy-duty steel trapezes and equipment supports. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations. Comply with AWS D1.1 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 contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

### 3.6 PAINTING

- A. Touching Up: 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. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils. See Division 9 Section "Painting" for paint materials and application requirements.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 230529

## 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 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
  - 1. Equipment nameplates.
  - 2. Equipment markers.
  - 3. Equipment signs.
  - 4. Duct markers.
  - 5. Stencils.
  - 6. Warning tags.

#### 1.3 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. Valve numbering scheme.
- D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

#### 1.5 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 location of access panels and doors.

- C. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.
  - 1. Data:
    - a. Manufacturer, product name, model number, and serial number.
    - b. Capacity, operating and power characteristics, and essential data.
    - c. Labels of tested compliances.
  - 2. Location: Accessible and visible.
  - 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
  - 1. Terminology: Match schedules as closely as possible.
  - 2. Data:
    - a. Name and plan number.
  - 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.
- C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.
  - 1. Data: Instructions for operation of equipment and for safety procedures.
  - 2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
  - 3. Thickness: 1/8 inch, unless otherwise indicated.
  - 4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

### 2.2 DUCT IDENTIFICATION DEVICES

- A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

## 2.3 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 markers, equipment markers, equipment signs, and similar operational instructions.
1. Stencil Material: Metal or fiberboard.
  2. Stencil Paint: Exterior, gloss, alkyd enamel or acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
  3. Identification Paint: Exterior, alkyd enamel or acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.

## 2.4 WARNING TAGS

- A. Warning Tags: 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. Color: Yellow background with black lettering.

# PART 3 - EXECUTION

## 3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

## 3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
1. Pumps, compressors, chillers, condensers, and similar motor-driven units.
  2. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
  3. Fans, blowers and air terminals.
  4. Air handling units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 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.
  2. Data: Distinguish among multiple units,
  3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
    - a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
    - b. Fire department hose valves and hose stations.
    - c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
    - d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
    - e. Air handling units, air terminals, and fan coil units.
    - f. Tanks and pressure vessels.
    - g. Humidifiers, water-treatment systems, and similar equipment.
- C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.
1. Identify mechanical equipment with equipment markers in the following color codes:
    - a. Green: For cooling equipment and components.
    - b. Yellow: For heating equipment and components.
    - c. Orange: For combination cooling and heating equipment and components.
    - d. Brown: For energy-reclamation equipment and components.
  2. Letter Size: Minimum 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.
  3. Data: Distinguish among multiple units, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
- E. Include signs for the following general categories of equipment:
1. Fans, blowers and air terminals.
- F. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- G. Install access panel markers with screws on equipment access panels.



### 3.3 DUCT IDENTIFICATION

- A. Install duct markers with permanent adhesive on air ducts in the following color codes:
  - 1. Green: For cold-air supply ducts.
  - 2. Yellow: For hot-air supply ducts.
  - 3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
  - 5. Letter Size: Minimum 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.
- B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.
- C. Locate markers 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.

### 3.4 WARNING-TAG INSTALLATION

- A. Write required message on, and attach warning tags to, equipment and other items where required.
- B. Provide warning tags on equipment and with wording as directed by the Architect.

### 3.5 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

### 3.6 CLEANING

- A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION 230553

## SECTION 230700 - HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe, including the following:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
  - c. Polyisocyanurate.
  - d. Polystyrene.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

- B. Related Sections include the following:

- 1. Division 23 Section "Metal Ducts" for duct liners.

#### 1.3 DEFINITIONS

- A. ASJ: All-service jacket.
- B. FSK: Foil, scrim, kraft paper.
- C. FSP: Foil, scrim, polyethylene.
- D. PVDC: Polyvinylidene chloride.

- E. SSL: Self-sealing lap.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings: Show details for the following:
  - 1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 3. Field application for each equipment type.

#### 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. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. National Commercial and Industrial Insulation Standards: Comply with installation standards.
- D. ASHRAE Standard 90.1-2004: Comply with insulation values required by the Energy Standards.

#### 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 size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

## 1.8 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 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Products: Subject to compliance with requirements, provide one of the products specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 INSULATION MATERIALS

- A. Refer to Part 3 schedule articles for requirements about where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Paint flexible Elastomeric insulation exposed to sun light with Armaflex WB finish, white.
  - 1. Products:

- a. Aeroflex USA Inc.; Aerocel.
  - b. Armacell LLC; AP Armaflex.
  - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation without factory-applied jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
  1. Products:
    - a. CertainTeed Corp.; Commercial Board.
    - b. Fibrex Insulations Inc.; FBX.
    - c. Johns Manville; 800 Series Spin-Glas.
    - d. Knauf Insulation; Insulation Board.
    - e. Manson Insulation Inc.; AK Board.
    - f. Owens Corning; Fiberglas 700 Series.
- H. Polyisocyanurate: Unfaced, preformed, rigid cellular polyisocyanurate material intended for use as thermal insulation.
  1. Products:
    - a. Apache Products Company; ISO-25.
    - b. Dow Chemical Company (The); Trymer.
    - c. Duna USA Inc.; Corafoam.
    - d. Elliott Company; Elfoam.
  2. Comply with ASTM C 591, Type I or Type IV, except thermal conductivity (k-value) shall not exceed 0.19 Btu x in./h x sq. ft. x deg F at 75 deg F after 180 days of aging.
  3. Flame-spread index shall be 25 or less and smoke-developed index shall be 50 or less for thickness up to 1-1/2 inches as tested by ASTM E 84.
  4. Fabricate shapes according to ASTM C 450 and ASTM C 585.
  5. Factory-Applied Jacket: Requirements are specified in Part 2 "Factory-Applied Jackets" Article.
    - a. Pipe Applications: ASJ-SSL.
    - b. Equipment Applications: ASJ or ASJ-SSL.
- I. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
  1. Products:
    - a. Dow Chemical Company (The); Styrofoam.
    - b. Knauf Insulation; Knauf Polystyrene.

## 2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.
  - 1. Products:
    - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
  - 1. Products:
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

## 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Products:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Products:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- D. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.

## 1. Products:

- a. Childers Products, Division of ITW; CP-96.
- b. Foster Products Corporation, H. B. Fuller Company; 97-13.

- 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:

- a. Childers Products, Division of ITW; CP-82.
- b. Foster Products Corporation, H. B. Fuller Company; 85-20.
- c. ITW TACC, Division of Illinois Tool Works; S-90/80.
- d. Marathon Industries, Inc.; 225.
- e. Mon-Eco Industries, Inc.; 22-25.

- F. PVC Jacket Adhesive: Compatible with PVC jacket.

## 1. Products:

- a. Dow Chemical Company (The); 739, Dow Silicone.
- b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
- c. P.I.C. Plastics, Inc.; Welding Adhesive.
- d. Red Devil, Inc.; Celulon Ultra Clear.
- e. Speedline Corporation; Speedline Vinyl Adhesive.

## 2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

## 1. Products:

- a. Childers Products, Division of ITW; CP-35.
- b. Foster Products Corporation, H. B. Fuller Company; 30-90.
- c. ITW TACC, Division of Illinois Tool Works; CB-50.
- d. Marathon Industries, Inc.; 590.
- e. Mon-Eco Industries, Inc.; 55-40.
- f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

3. Service Temperature Range: Minus 20 to plus 180 deg F.

4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

5. Color: White.

- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.

1. Products:
  - a. Childers Products, Division of ITW; CP-30.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-35.
  - c. ITW TACC, Division of Illinois Tool Works; CB-25.
  - d. Marathon Industries, Inc.; 501.
  - e. 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:
  - a. Childers Products, Division of ITW; Encacel.
  - b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
  - c. Marathon Industries, Inc.; 570.
  - d. Mon-Eco Industries, Inc.; 55-70.
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:
  - a. Childers Products, Division of ITW; CP-10.
  - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
  - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
  - d. Marathon Industries, Inc.; 550.
  - e. Mon-Eco Industries, Inc.; 55-50.
  - f. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 200 deg F.
4. Solids Content: 63 percent by volume and 73 percent by weight.
5. Color: White.

## 2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products:



- a. Childers Products, Division of ITW; CP-52.
  - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
  - c. Marathon Industries, Inc.; 130.
  - d. Mon-Eco Industries, Inc.; 11-30.
  - e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
  3. Service Temperature Range: Minus 50 to plus 180 deg F.
  4. Color: White.

## 2.7 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic-Foam, and Polyisocyanurate Products:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products:
  - a. Childers Products, Division of ITW; CP-70.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
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.

### B. FSK and Metal Jacket Flashing Sealants:

1. Products:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products:

- a. Childers Products, Division of ITW; CP-76.
- b. Materials shall be compatible with insulation materials, jackets, and substrates.
- c. Fire- and water-resistant, flexible, elastomeric sealant.
- d. Service Temperature Range: Minus 40 to plus 250 deg F.
- e. Color: White.

## 2.8 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:

- a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## 2.9 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
- b. Compac Corp.; 104 and 105.
- c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
- 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 and UL listed.

1. Products:

- a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
- b. Compac Corp.; 110 and 111.
- c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
- d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/ inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. 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 and UL listed.
1. Products:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/ inch in width.
- E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 4 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/ inch in width.
- F. PVDC Tape for Outdoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products:
  - a. Dow Chemical Company (The); Saran 560 Vapor Retarder Tape.
2. Width: 3 inches.
3. Film Thickness: 6 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/ inch in width.

## 2.10 SECUREMENTS

### A. Bands:

1. Products:
  - a. Childers Products; Bands.
  - b. PABCO Metals Corporation; Bands.
  - c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing or closed seal.
3. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **[0.106-inch]** **[0.135-inch]** diameter shank, length to suit depth of insulation indicated.
  - a. Products:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; CD.
    - 3) Midwest Fasteners, Inc.; CD.
    - 4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, **[0.106-inch-]** **[0.135-inch]** diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
  - a. Products:
    - 1) AGM Industries, Inc.; CWP-1.
    - 2) GEMCO; Cupped Head Weld Pin.
    - 3) Midwest Fasteners, Inc.; Cupped Head.

- 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) GEMCO; Nylon Hangers.
    - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
  - a. Products:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
    - 4) Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

- b. Spindle: Copper- or zinc-coated, low carbon steel, Aluminum, or Stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
    - c. Adhesive-backed base with a peel-off protective cover.
  - 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel, aluminum, or stainless-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:
      - 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.
  - 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
    - a. Manufacturers:
      - 1) GEMCO.
      - 2) Midwest Fasteners, Inc.
- C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.
- D. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel, or 0.062-inch soft-annealed, galvanized steel.
  - 1. Manufacturers:
    - a. ACS Industries, Inc.
    - b. C & F Wire.
    - c. Childers Products.
    - d. PABCO Metals Corporation.
    - e. RPR Products, Inc.

## 2.11 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 (ASTM B 209M), 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 **[304] [316] [304 or 316]**.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  - 1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  - 2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 COMMON INSTALLATION REQUIREMENTS

- A. Install insulation in strict accordance with the manufacturer's installation instructions and the National Commercial and Industrial Insulation Standards.
- B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- D. 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.
- E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- F. Install multiple layers of insulation with longitudinal and end seams staggered.
- G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- H. Keep insulation materials dry during application and finishing.
- I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- J. Install insulation with least number of joints practical.
- K. 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.
- L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- M. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at **[2 inches] [4 inches]** o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.



- P. 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.
- Q. 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 Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. 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. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Through-Penetration Firestop Systems."

### 3.5 DUCT AND PLENUM INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
  - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

### 3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 MINERAL-FIBER INSULATION INSTALLATION

- A. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

- a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
  - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
  - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
  - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3-inches.
  5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.8 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 exhaust between isolation damper and penetration of building exterior.
4. Indoor, exposed exhaust between isolation damper and penetration of building exterior.
5. Outdoor, above ground exposed supply and return.

#### B. Items Not Insulated:

1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.

3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.
8. Exposed supply ductwork outside of the mechanical room, in an occupied area being conditioned by the supply ductwork

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Exposed, round and flat-oval, outdoor-air duct insulation shall be any of the following:
  1. Flexible Elastomeric: 2-inches thick.
  2. Mineral-Fiber Board: 2-inches thick and 2-lb/cu. ft. nominal density.
- B. Exposed, round and flat-oval, exhaust-air duct insulation shall be any of the following:
  1. Flexible Elastomeric: 2-inches thick.
  2. Mineral-Fiber Board: 2-inches thick and 2-lb/cu. ft. nominal density.

END OF SECTION 230700

## SECTION 231123 - FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Pipes, tubes, and fittings.
  - 2. Piping specialties.
  - 3. Piping and tubing joining materials.
  - 4. Valves.
  - 5. Pressure regulators.
  - 6. Service meters.
  - 7. Mechanical sleeve seals.
  - 8. Grout.
  - 9. Concrete bases.

#### 1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Minimum Operating-Pressure Ratings:
  - 1. Piping and Valves: 100 psig minimum unless otherwise indicated.
  - 2. Service Regulators: 65 psig minimum unless otherwise indicated.
  - 3. Minimum Operating Pressure of Service Meter: 5 psig
- B. Natural-Gas System Pressure within Buildings: 0.5 psig or less

- C. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.
- D. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressure of more than 0.5 psig but not more than 2 psig.
- E. Natural-Gas System Pressures within Buildings: Three pressure ranges. Primary pressure is more than 2 psig but not more than 5 psig, and is reduced to secondary pressures of more than 0.5 psig but not more than 2 psig, and is reduced again to pressures of 0.5 psig or less.
- F. Delegated Design: Design restraints and anchors for natural-gas piping and equipment, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

## 1.5 SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Piping specialties.
  - 2. Corrugated, stainless-steel tubing with associated components.
  - 3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
  - 4. Pressure regulators. Indicate pressure ratings and capacities.
  - 5. Dielectric fittings.
  - 6. Mechanical sleeve seals.
  - 7. Escutcheons.
- 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. Shop Drawing Scale: 1/4 inch per foot
  - 2. Detail mounting, supports, and valve arrangements for pressure regulator assembly.
- C. Delegated-Design Submittal: For natural-gas piping and equipment 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 seismic restraints.
  - 2. Design Calculations: Calculate requirements for selecting seismic restraints.
- D. 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.
- E. Site Survey: Plans, drawn to scale, on which natural-gas piping is shown and coordinated with other services and utilities.

- F. Qualification Data: For qualified professional engineer.
- G. Welding certificates.
- H. Field quality-control reports.
- I. 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 according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.
- B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.
- 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.
- B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:
  - 1. Notify Owner no fewer than three days in advance of proposed interruption of natural-gas service.
  - 2. Do not proceed with interruption of natural-gas service without Owner's written permission.

## 1.9 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.
- B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

## PART 2 - PRODUCTS

### 2.1 PIPES, TUBES, AND FITTINGS

- A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
  - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.
  - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
  - 4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
    - a. Material Group: 1.1.
    - b. End Connections: Threaded or butt welding to match pipe.
    - c. Lapped Face: Not permitted underground.
    - d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.
  - 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.
  - 6. Mechanical Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dresser Piping Specialties; Division of Dresser, Inc.
      - 2) Smith-Blair, Inc.
    - b. Stainless-steel flanges and tube with epoxy finish.
    - c. Buna-nitrile seals.
    - d. Stainless-steel bolts, washers, and nuts.
    - e. Coupling shall be capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.



- f. Steel body couplings installed underground on plastic pipe shall be factory equipped with anode.
- B. Corrugated, Stainless-Steel Tubing: Comply with ANSI/IAS LC 1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. OmegaFlex, Inc.
    - b. Parker Hannifin Corporation; Parflex Division.
    - c. Titeflex.
    - d. Tru-Flex Metal Hose Corp.
  - 2. Tubing: ASTM A 240/A 240M, corrugated, Series 300 stainless steel.
  - 3. Coating: PE with flame retardant.
    - a. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      - 1) Flame-Spread Index: 25 or less.
      - 2) Smoke-Developed Index: 50 or less.
  - 4. Fittings: Copper-alloy mechanical fittings with ends made to fit and listed for use with corrugated stainless-steel tubing and capable of metal-to-metal seal without gaskets. Include brazing socket or threaded ends complying with ASME B1.20.1.
  - 5. Striker Plates: Steel, designed to protect tubing from penetrations.
  - 6. Manifolds: Malleable iron or steel with factory-applied protective coating. Threaded connections shall comply with ASME B1.20.1 for pipe inlet and corrugated tubing outlets.
  - 7. Operating-Pressure Rating: 5 psig.
- C. Aluminum Tubing: Comply with ASTM B 210 and ASTM B 241/B 241M.
  - 1. Aluminum Alloy: Alloy 5456 is prohibited.
  - 2. Protective Coating: Factory-applied coating capable of resisting corrosion on tubing in contact with masonry, plaster, insulation, water, detergents, and sewerage.
  - 3. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper-alloy fittings.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads shall comply with ASME B1.20.3.
- D. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K.
  - 1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  - 2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.
    - a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.
    - b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- E. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.
1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.
  2. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
  3. Protective Coating for Underground Tubing: Factory-applied, extruded PE a minimum of 0.022 inch thick.
- F. Tin-Lined Copper Tube: ASTM B 280, seamless, annealed, with interior tin-plated lining.
1. Flare Fittings: Comply with ASME B16.26 and SAE J513.
    - a. Copper fittings with long nuts.
    - b. Metal-to-metal compression seal without gasket.
    - c. Dryseal threads complying with ASME B1.20.3.
- G. PE Pipe: ASTM D 2513, SDR 11.
1. PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.
  2. PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
  3. Anodeless Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.
    - b. Casing: Steel pipe complying with ASTM A 53/A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering.
    - c. Aboveground Portion: PE transition fitting.
    - d. Outlet shall be threaded or flanged or suitable for welded connection.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.
    - g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
  4. Transition Service-Line Risers: Factory fabricated and leak tested.
    - a. Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet connected to steel pipe complying with ASTM A 53/A 53M, Schedule 40, Type E or S, Grade B, with corrosion-protective coating for aboveground outlet.
    - b. Outlet shall be threaded or flanged or suitable for welded connection.
    - c. Bridging sleeve over mechanical coupling.
    - d. Factory-connected anode.
    - e. Tracer wire connection.
    - f. Ultraviolet shield.

- g. Stake supports with factory finish to match steel pipe casing or carrier pipe.
- 5. Plastic Mechanical Couplings, NPS 1-1/2 and Smaller: Capable of joining PE pipe to PE pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lyall, R. W. & Company, Inc.
    - 2) Mueller Co.; Gas Products Div.
    - 3) Perfection Corporation; a subsidiary of American Meter Company.
  - b. PE body with molded-in, stainless-steel support ring.
  - c. Buna-nitrile seals.
  - d. Acetal collets.
  - e. Electro-zinc-plated steel stiffener.
- 6. Plastic Mechanical Couplings, NPS 2 and Larger: Capable of joining PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Lyall, R. W. & Company, Inc.
    - 2) Mueller Co.; Gas Products Div.
    - 3) Perfection Corporation; a subsidiary of American Meter Company.
  - b. Fiber-reinforced plastic body.
  - c. PE body tube.
  - d. Buna-nitrile seals.
  - e. Acetal collets.
  - f. Stainless-steel bolts, nuts, and washers.
- 7. Steel Mechanical Couplings: Capable of joining plain-end PE pipe to PE pipe, steel pipe to PE pipe, or steel pipe to steel pipe.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Dresser Piping Specialties; Division of Dresser, Inc.
    - 2) Smith-Blair, Inc.
  - b. Stainless steel flanges and tube with epoxy finish.
  - c. Buna-nitrile seals.
  - d. Stainless steel bolts, washers, and nuts.
  - e. Factory-installed anode for steel-body couplings installed underground.

## 2.2 PIPING SPECIALTIES

### A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
  2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
  3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
  4. Corrugated stainless-steel tubing with polymer coating.
  5. Operating-Pressure Rating: 0.5 psig.
  6. End Fittings: Zinc-coated steel.
  7. Threaded Ends: Comply with ASME B1.20.1.
  8. Maximum Length: 72 inches
- B. Quick-Disconnect Devices: Comply with ANSI Z21.41.
1. Copper-alloy convenience outlet and matching plug connector.
  2. Nitrile seals.
  3. Hand operated with automatic shutoff when disconnected.
  4. For indoor or outdoor applications.
  5. Adjustable, retractable restraining cable.
- C. Y-Pattern Strainers:
1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
  2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- D. 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: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
  4. CWP Rating: 125 psig.
- E. T-Pattern Strainers:
1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
  2. End Connections: Grooved ends.
  3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
  4. CWP Rating: 750 psi
- F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

## 2.3 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for natural gas.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

## 2.4 MANUAL GAS SHUTOFF VALVES

- A. See "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles for where each valve type is applied in various services.
- B. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.
  - 1. CWP Rating: 125 psig
  - 2. Threaded Ends: Comply with ASME B1.20.1.
  - 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
  - 4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.
  - 6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.
- C. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.
  - 1. CWP Rating: 125 psig
  - 2. Flanged Ends: Comply with ASME B16.5 for steel flanges.
  - 3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
  - 4. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- D. One-Piece, Bronze Ball Valve with Bronze Trim: MSS SP-110.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. BrassCraft Manufacturing Company; a Masco company.
    - b. Conbraco Industries, Inc.; Apollo Div.
    - c. Lyall, R. W. & Company, Inc.
    - d. McDonald, A. Y. Mfg. Co.
    - e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated brass.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Separate packnut with adjustable-stem packing threaded ends.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

E. 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. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE; blowout proof.
6. Packing: Threaded-body packnut design with adjustable-stem packing.
7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

F. Two-Piece, Regular-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. BrassCraft Manufacturing Company; a Masco company.
  - b. Conbraco Industries, Inc.; Apollo Div.
  - c. Lyall, R. W. & Company, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Perfection Corporation; a subsidiary of American Meter Company.
2. Body: Bronze, complying with ASTM B 584.
3. Ball: Chrome-plated bronze.
4. Stem: Bronze; blowout proof.
5. Seats: Reinforced TFE.
6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
8. CWP Rating: 600 psig.
9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

G. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Lee Brass Company.
  - b. McDonald, A. Y. Mfg. Co.
2. Body: Bronze, complying with ASTM B 584.
3. Plug: Bronze.
4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.
5. Operator: Square head or lug type with tamperproof feature where indicated.
6. Pressure Class: 125 psig.
7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

H. Cast-Iron, Nonlubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. McDonald, A. Y. Mfg. Co.
  - b. Mueller Co.; Gas Products Div.
  - c. Xomox Corporation; a Crane company.
2. Body: Cast iron, complying with ASTM A 126, 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 shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

I. Cast-Iron, Lubricated Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Flowserve.
    - b. Homestead Valve; a division of Olson Technologies, Inc.
    - c. McDonald, A. Y. Mfg. Co.
    - d. Milliken Valve Company.
    - e. Mueller Co.; Gas Products Div.
    - f. R&M Energy Systems, A Unit of Robbins & Myers, Inc.
  2. Body: Cast iron, complying with ASTM A 126, 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 shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.
  10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.
- J. PE Ball Valves: Comply with ASME B16.40.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Kerotest Manufacturing Corp.
    - b. Lyall, R. W. & Company, Inc.
    - c. Perfection Corporation; a subsidiary of American Meter Company
  2. Body: PE.
  3. Ball: PE.
  4. Stem: Acetal.
  5. Seats and Seals: Nitrile.
  6. Ends: Plain or fusible to match piping.
  7. CWP Rating: 80 psig
  8. Operating Temperature: Minus 20 to plus 140 deg
  9. Operator: Nut or flat head for key operation.
  10. Include plastic valve extension.
  11. Include tamperproof locking feature for valves where indicated on Drawings.
- K. Valve Boxes:
1. Cast-iron, two-section box.
  2. Top section with cover with "GAS" lettering.
  3. Bottom section with base to fit over valve and barrel a minimum of 5 inches in diameter.
  4. Adjustable cast-iron extensions of length required for depth of bury.
  5. Include tee-handle, steel operating wrench with socket end fitting valve nut or flat head, and with stem of length required to operate valve.



## 2.5 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 Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide comparable product by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - d. Invensys.
  - e. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

### C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide comparable product by one of the following:
  - a. Actaris.
  - b. American Meter Company.
  - c. Dungs.
  - d. Eclipse Combustion, Inc.
  - e. Fisher Control Valves and Regulators; Division of Emerson Process Management.
  - f. Invensys.
  - g. Maxitrol Company.
  - h. Richards Industries; Jordan Valve Div.
2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.
6. Orifice: Aluminum; interchangeable.
7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.
9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.
10. Overpressure Protection Device: Factory mounted on pressure regulator.
11. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.
12. Maximum Inlet Pressure: 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 Inc.
  - b. Eaton Corporation; Controls Div.
  - c. Harper Wyman Co.
  - d. Maxitrol Company.
  - e. SCP, Inc.
2. Body and Diaphragm Case: Die-cast aluminum.
3. Springs: Zinc-plated steel; interchangeable.
4. Diaphragm Plate: Zinc-plated steel.
5. Seat Disc: Nitrile rubber.
6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.
7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.
8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.
9. Maximum Inlet Pressure: 5 psig

## 2.6 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Hart Industries International, Inc.
  - d. McDonald, A. Y. Mfg. Co.
  - e. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - f. Wilkins; Zurn Plumbing Products Group.

2. Minimum Operating-Pressure Rating: 150 psig
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Capitol Manufacturing Company.
  - b. Central Plastics Company.
  - c. Watts Regulator Co.; Division of Watts Water Technologies, Inc.
  - d. Wilkins; Zurn Plumbing Products Group.
2. Minimum Operating-Pressure Rating: 150 psig
3. Combination fitting of copper alloy and ferrous materials.
4. Insulating materials suitable for natural gas.
5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Advance Products & Systems, Inc.
  - b. Calpico Inc.
  - c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
2. Minimum Operating-Pressure Rating: 150 psig
3. Companion-flange assembly for field assembly.
4. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.
5. Insulating materials suitable for natural gas.
6. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.7 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

## 2.8 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico Inc.
    - c. Metraflex Company (The).
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.
  - 3. Pressure Plates: Plastic
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

## 2.9 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.
- B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Escutcheons: With set screw.
  - 1. Finish: Polished chrome-plated
- D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated
- E. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.
- G. One-Piece, Floor-Plate Escutcheons: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

## 2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.

1. Characteristics: Post-hardening, volume adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

## 2.11 LABELING AND IDENTIFYING

- A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Close equipment shutoff valves before turning off natural gas to premises or piping section.
- B. Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.
- C. Comply with NFPA 54 requirements for prevention of accidental ignition.

### 3.3 OUTDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 for installation and purging of natural-gas piping.
- B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "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 according to ASTM D 2774.
- D. Steel Piping with Protective Coating:
  1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.

2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
  3. Replace pipe having damaged PE coating with new pipe.
- E. Copper Tubing with Protective Coating:
1. Apply joint cover kits over tubing to cover, seal, and protect joints.
  2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer.
- F. Install fittings for changes in direction and branch connections.
- G. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
- H. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- I. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- J. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### 3.4 INDOOR PIPING INSTALLATION

- A. Comply with NFPA 54 installation and purging of natural-gas piping.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- E. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

- G. Locate valves for easy access.
- H. Install natural-gas piping at uniform grade 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. Install escutcheons at penetrations of interior walls, ceilings, and floors.
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - d. Piping at Ceiling Penetrations in Finished Spaces: One-piece cast-brass type with polished chrome-plated finish.
    - e. Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type and set screw.
    - f. Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished finish.
    - g. Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw;
- L. 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 in Division 07 Section "Penetration Firestopping."
- M. Verify final equipment locations for roughing-in.
- N. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.
- O. 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.
- P. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.
- Q. 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.

- R. 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.
- S. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- T. Connect branch piping from top or side of horizontal piping.
- U. 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.
- V. Do not use natural-gas piping as grounding electrode.
- W. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.
- X. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

### 3.5 SERVICE-METER ASSEMBLY INSTALLATION

- A. Install service-meter assemblies aboveground.
- 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 Division 05 Section "Metal Fabrications" for pipe bollards.

### 3.6 VALVE INSTALLATION

- A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.
- B. Install underground valves with valve boxes.
- C. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.
- D. Install earthquake valves aboveground outside buildings according to listing.
- E. Install anode for metallic valves in underground PE piping.

### 3.7 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints:
  - 1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.
  - 2. Cut threads full and clean using sharp dies.
  - 3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.
  - 4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.
  - 5. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints:
  - 1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.
  - 2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.
- F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.
- G. Flared Joints: Cut tubing with roll cutting tool. Flare tube end with tool to result in flare dimensions complying with SAE J513. Tighten finger tight, then use wrench. Do not overtighten.
- H. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  1. Plain-End Pipe and Fittings: Use butt fusion.
  2. Plain-End Pipe and Socket Fittings: Use socket fusion.

### 3.8 HANGER AND SUPPORT INSTALLATION

- A. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
  1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
  2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
  4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
  5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.
- B. Install hangers for horizontal drawn-temper copper tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2 and NPS 5/8: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and NPS 7/8: Maximum span, 84 inches; minimum rod size, 3/8 inch.
  4. NPS 1: Maximum span, 96 inches; minimum rod size, 3/8 inch.
- C. Install hangers for horizontal, corrugated stainless-steel tubing with the following maximum spacing and minimum rod sizes:
  1. NPS 3/8: Maximum span, 48 inches; minimum rod size, 3/8 inch.
  2. NPS 1/2: Maximum span, 72 inches; minimum rod size, 3/8 inch.
  3. NPS 3/4 and Larger: Maximum span, 96 inches; minimum rod size, 3/8 inch.

### 3.9 CONNECTIONS

- A. Connect to utility's gas main according to utility's procedures and requirements.

- B. Install natural-gas piping electrically continuous, and bonded to gas appliance equipment grounding conductor of the circuit powering the appliance according to NFPA 70.
- C. Install piping adjacent to appliances to allow service and maintenance of appliances.
- D. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.
- E. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

### 3.10 LABELING AND IDENTIFYING

- A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification. Install detectable warning tape directly above gas piping, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

### 3.11 PAINTING

- A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.
- B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Alkyd System: MPI EXT 5.1D.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel semigloss
    - d. Color: Yellow
- C. Paint exposed, interior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.
  - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior latex matching topcoat.
    - c. Topcoat: Interior latex semigloss.
    - d. Color: Yellow
  - 2. Alkyd System: MPI INT 5.1E.
    - a. Prime Coat: Alkyd anticorrosive metal primer.
    - b. Intermediate Coat: Interior alkyd matching topcoat.

- c. Topcoat: Interior alkyd semigloss
- d. Color: Yellow

- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

### 3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Test, inspect, and purge natural gas according to NFPA 54, the International Fuel Gas Code, and authorities having jurisdiction.
- C. Natural-gas piping will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.13 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain earthquake valves.

### 3.14 OUTDOOR PIPING SCHEDULE

- A. Underground natural-gas piping shall be one of the following:
  - 1. PE pipe and fittings joined by heat fusion, or mechanical couplings; service-line risers with tracer wire terminated in an accessible location.
  - 2. Steel pipe with wrought-steel fittings and welded joints, or mechanical couplings. Coat pipe and fittings with protective coating for steel piping.
  - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints. Coat pipe and fittings with protective coating for copper tubing.
- B. Aboveground natural-gas piping shall be one of the following:
  - 1. Steel pipe with malleable-iron fittings and threaded joints.
  - 2. Steel pipe with wrought-steel fittings and welded joints.
  - 3. Annealed-temper copper tube with wrought-copper fittings and brazed joints.
- C. Branch Piping in Cast-in-Place Concrete to Single Appliance: Annealed-temper copper tube with wrought-copper fittings and brazed joints. Install piping embedded in concrete with no joints in concrete.
- D. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.

## 3.15 INDOOR PIPING SCHEDULE FOR SYSTEM PRESSURES LESS THAN 0.5 PSIG

- A. Aboveground, branch piping NPS 1 and smaller shall be one of the following:
1. Corrugated stainless-steel tubing with mechanical fittings having socket or threaded ends to match adjacent piping.
  2. Annealed-temper, tin-lined copper tube with flared joints and fittings.
  3. Annealed-temper, copper tube with wrought-copper fittings and brazed joints.
  4. Aluminum tube with flared fittings and joints.
  5. Steel pipe with malleable-iron fittings and threaded joints.
- B. Aboveground, distribution piping shall be one of the following:
1. Steel pipe with malleable-iron fittings and threaded joints.
  2. Steel pipe with wrought-steel fittings and welded joints.
  3. Drawn-temper copper tube with wrought-copper fittings and brazed joints.
- C. Containment Conduit: Steel pipe with wrought-steel fittings and welded joints. Coat pipe and fittings with protective coating for steel piping.
- D. Containment Conduit Vent Piping: Steel pipe with malleable-iron fittings and threaded or wrought-steel fittings with welded joints. Coat underground pipe and fittings with protective coating for steel piping.

## 3.16 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

- A. Valves for pipe sizes NPS 2 and smaller at service meter shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.
- B. Distribution piping valves for pipe sizes NPS 2 and smaller shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.
- C. Valves in branch piping for single appliance shall be one of the following:
1. One-piece, bronze ball valve with bronze trim.
  2. Two-piece, full-port, bronze ball valves with bronze trim.
  3. Bronze plug valve.

END OF SECTION 231123

## SECTION 233113 – METAL DUCTS

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 10-inch wg. Metal ducts include the following:
  - 1. Rectangular ducts and fittings.
  - 2. Single-wall, round, and flat-oval spiral-seam ducts and formed fittings.
  - 3. Double-wall, round, and flat-oval spiral-seam ducts and formed fittings.
  - 4. Duct liner.
- B. Related Sections include the following:
  - 1. Division 23 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

## 1.3 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and -distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Engineer. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.
- B. Drawings are diagrammatical and shall not be used as a shop drawing for fabrication. The contractor is responsible to coordinate with other trades and adjustments in elevation and routings as required to meet the project requirements.

## 1.4 SUBMITTALS

- A. Shop Drawings: CAD-generated and drawn to 1/4 inch equals 1 foot (1:50) scale. Show fabrication and installation details for metal ducts.
  - 1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
  - 2. Duct layout indicating sizes and pressure classes.
  - 3. Elevations of top and bottom of ducts.

4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.

- B. Field quality-control test reports.

## 1.5 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel," for hangers and supports.
- B. NFPA Compliance:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- C. Comply with NFPA 96, "Ventilation Control and Fire Protection of Commercial Cooking Operations," Ch. 3, "Duct System," for range hood ducts, and the Michigan Department of Public Health Manual of Ventilation Systems for Food Service Establishments.

## 1.6 COORDINATION

- A. The contractor is responsible for coordination with other trades and maintaining required clearances for access and servicing of equipment.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 SHEET METAL MATERIALS

- A. 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 (Z275) coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.
- C. PVC-Coated Galvanized Steel: Acceptable by authorities having jurisdiction for use in fabricating ducts with UL 181, Class 1 listing. Lock-forming-quality, galvanized sheet steel complying with ASTM A 653/A 653M and having G60 (Z180) coating designation. Factory-applied PVC coatings shall be 4 mils thick on sheet metal surfaces of ducts and fittings exposed to corrosive conditions and 2 mils thick on opposite surfaces.
- D. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets; commercial quality; with oiled, matte finish for exposed ducts.
- E. Stainless Steel: ASTM A 480/A 480M, Type 316, and having a No. 2D finish for concealed ducts and for exposed ducts.
- F. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- G. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
- 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.

## 2.3 RECTANGULAR FITTING CONSTRUCTION

- A. General: Construct fittings in accordance with SMACNA HVAC Duct Construction Standards. Use low loss fittings.
- B. Elbows: Use full radius type with inside radius equal to the duct width except where space limits use. Where square elbows are shown or used, provide turning vanes. Use airfoil type vanes where duct velocities exceed 2000 fpm.
- C. Transitions: Construct transitions between duct sizes with tapered fittings. Use 22.5-degree maximum angle per side for diverging transitions and 30-degree maximum angle for converging transitions.
- D. Divided Flow Fittings: Use full radiused tees, square tees with turning vanes, or enlarged branch connections with 45-degree entry equal to 1/4 times the duct width. Round branch ducts to rectangular ducts may be conical or enlarged rectangular to round fittings with 45 degree enlarged entry. Round taps serving individual diffusers may be straight taps where branch duct velocities are less than 800 fpm.

## 2.4 DUCT LINER

- A. Fibrous-Glass Liner: Comply with NFPA 90A or NFPA 90B and with NAIMA AH124.
  - 1. Manufacturers:



- a. CertainTeed Corp.; Insulation Group.
    - b. Johns Manville International, Inc.
    - c. Knauf Fiber Glass GmbH.
    - d. Owens Corning.
  2. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
    - a. Thickness: 1 inch unless otherwise indicated.
    - b. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
    - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
    - d. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - e. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
  3. Tensile Strength: Indefinitely sustain a 50-lb- tensile, dead-load test perpendicular to duct wall.
  4. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
  5. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
- B. Flexible Elastomeric Duct Liner: Comply with NFPA 90A or NFPA 90B.
1. Manufacturers:
    - a. Armstrong World Industries, Inc.
  2. Materials: Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.
    - a. Thickness: 3/4 inch.
    - b. Thermal Conductivity (k-Value): 0.24 at 75 deg F mean temperature.
    - c. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.
    - d. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

## 2.5 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Joint and Seam Tape: 2 inches wide; glass-fiber-reinforced fabric.

- C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
- D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

## 2.6 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
  - 2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
- B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
  - 1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
  - 2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for steel sheet width and thickness and for steel rod diameters.
  - 3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
  - 3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

## 2.7 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
  2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Nexus Inc.
    - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
1. Manufacturers:
    - a. Ductmate Industries, Inc.
    - b. Lockformer.
  2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
  3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
- D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

## 2.8 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Longitudinal- and Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.
1. Manufacturers:
    - a. McGill AirFlow Corporation.
    - b. SEMCO Incorporated.
    - c. Dixie Sheet Metal Products.
    - d. Foremost.
    - e. Lindab.
- D. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
  - a. Manufacturers:
    - 1) Lindab Inc.
5. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
  - a. Manufacturers:
    - 1) Ductmate Industries, Inc.
    - 2) McGill AirFlow Corporation.
    - 3) SEMCO Incorporated.
- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reducing entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:
    - a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
    - b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
    - d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
    - a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
    - b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
    - c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.

- d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.
  - 4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  - 5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  - 6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  - 7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  - 8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
  - 9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.
  - 10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
  - 11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
  - 12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.
- H. PVC-Coated Elbows and Fittings: Fabricate elbows and fittings as follows:
- 1. Round Elbows 4 to 8 Inches in Diameter: Two piece, die stamped, with longitudinal seams spot welded, bonded, and painted with PVC aerosol spray.
  - 2. Round Elbows 9 to 26 Inches in Diameter: Standing-seam construction.
  - 3. Round Elbows 28 to 60 Inches in Diameter: Standard gored construction riveted and bonded.
  - 4. Other Fittings: Riveted and bonded joints.
  - 5. Couplings: Slip-joint construction with a minimum 2-inch insertion length.

## PART 3 - EXECUTION

### 3.1 DUCT APPLICATIONS

- A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:
- 1. Supply Ducts: 2-inch wg.
  - 2. Supply Ducts (before Air Terminal Units): 6-inch wg.
  - 3. Supply Ducts (after Air Terminal Units): 1-inch wg.
  - 4. Return Ducts (Negative Pressure): 1-inch wg.
  - 5. Exhaust Ducts (Negative Pressure): 2-inch wg.
- B. All ducts shall be galvanized steel except as follows:

1. Range Hood Exhaust Ducts: Comply with NFPA 96.
  - a. Concealed: Carbon-steel sheet.
  - b. Exposed: Type 304, stainless steel with finish to match kitchen equipment and range hood.
  - c. Weld and flange seams and joints.
2. Dishwasher Hood Exhaust Ducts:
  - a. Type 304, stainless steel with finish to match kitchen equipment and range hood. Weld and flange seams and joints.
  - b. Aluminum, with seams and laps arranged on top of duct.
3. Acid-Resistant (Fume-Handling) Ducts: PVC-coated galvanized steel with thicker coating on duct interior.
4. Underground Ducts: PVC-coated galvanized steel with thicker coating on duct exterior.

### 3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- C. Install ducts with fewest possible joints.
- D. Install fabricated fittings for changes in directions, size, and shape and for connections.
- E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
  1. Offsets and transitions as required to coordinate with other trades and equipment are the responsibility of the contractor.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
  1. Where ducts pass over light fixtures, maintain a minimum elevation of 6-inches above finish ceiling, or more as required by the light fixtures.

- K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches. Provide sheet metal flanges on both sides of walls, exposed or concealed for sound sensitive walls.
- N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 23 Section "Duct Accessories." Firestopping materials and installation methods are specified in Division 7 Section "Through-Penetration Firestop Systems."
- O. Protect duct interiors from the elements and foreign materials until building is enclosed.
- P. Paint interiors of metal ducts, that do not have duct liner, for 24 inches upstream of registers and grilles where line of sight permits view of ducts. Apply one coat of flat, black, latex finish coat over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections.
- Q. Connections to existing equipment: Duct connections to equipment shall be full size to match the specific equipment used.
  - 1. Provide tapered transitions to equipment.
  - 2. Adjust ductwork configuration to match equipment used on project.

### 3.3 PVC-COATED DUCT, SPECIAL INSTALLATION REQUIREMENTS

- A. Repair damage to PVC coating with manufacturer's recommended materials.

### 3.4 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.
  - 1. For pressure classes lower than 2-inch wg, seal transverse joints.
- B. Seal ducts before external insulation is applied.

### 3.5 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

- B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
- C. Install concrete inserts before placing concrete.
- D. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
  - 1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
  - 2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
  - 3. Determine leakage from entire system or section of system by relating leakage to surface area of test section.
    - a. Allowable Leakage, Supply Duct Systems: 1 percent of design airflow.
    - b. Allowable Leakage, Return Duct Systems: 2 percent of design airflow.
    - c. Allowable Leakage, Exhaust Supply Duct Systems: 2 percent of design airflow.
    - d. Allowable Leakage, Supply Duct Systems, Terminals to Air Outlets: 2 percent of design airflow.
  - 4. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
  - 5. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

END OF SECTION 233113



## SECTION 233300 – AIR DUCT ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Flexible connectors.
  - 2. Louvers and Vents.

## 1.2 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. NFPA Compliance:
  - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 FLEXIBLE CONNECTORS

- A. Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
  - 1. Factory fabricate with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets.
  - 2. Conventional, Indoor System Flexible Connector Fabric: Glass fabric double coated with polychloroprene.
    - a. Minimum Weight: 26 oz./sq. yd..
    - b. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

## 2.3 LOUVERS AND VENTS

- A. General: Provide louvers and vents capable of withstanding the effects of gravity loads, wind loads and thermal movement. Wind loads shall be based on 30 pounds per square foot acting inward or outward.
1. Provide frame types and extended sills compatible with construction details.
    - a. Provide flanged frame where indicated.
  2. Provide screen at interior face of each exterior louver.
  3. Louver Screen Frames: Same kind and form of metal as indicated for louver to which screens are attached.
- B. Materials:
1. Aluminum Extrusions: ASTM B 221, alloy 6063-T5 or T-52.
  2. Aluminum Sheet: ASTM B 209, alloy 3003 or 5005.
  3. Galvanized Steel Sheet: ASTM A 653/A 653M, G 90 (Z275) zinc coating, mill phosphatized.
  4. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. [4] [6] finish.
  5. Fasteners: Of same basic metal and alloy as fastened metal or 300 Series stainless steel.
  6. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.
- C. Fabrication, General:
1. Fabricate frames to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
  2. Join frame members to each other and to louver blades with fillet welds concealed from view.
  3. Join frame members to each other and to louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer, concealed from view.
- D. AMCA Seal: Mark units with AMCA Certified Ratings Seal.
- E. Extruded Aluminum Double Drainable Blade
1. Frame: Four-inch deep .090 inch nominal wall thickness, 6064T5 extruded aluminum.
  2. Blades: 6063T5 extruded aluminum, .081 inch nominal wall thickness, double drainable blades at 45 deg. angle.
  3. Finish: Mill finish.
  4. Reference Product: Ruskin ELF811DD.
- F. Roll Formed Steel, Double Drainable Blade
1. Frame: 6-inch deep, 18-gage galvanized steel.
  2. Blades: 18-gage galvanized steel, 37½ deg angle, and with drain gutters in each blade.
  3. Screen: ½-inch mesh x 19-gage galvanized bird screen in a removable frame.
  4. Finish: Baked enamel finish in standard color selected by Architect.

G. Louver variations where scheduled on drawings:

1. Hinged frame.
2. Front or rear security bars.
3. Filter Rack for 2-inch filters.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors.
- G. Install balance dampers on all branch ducts serving diffusers and grilles.
- H. Coordinate installation of roof curbs with general trades.

END OF SECTION 233300

## SECTION 235533 - GAS-FIRED UNIT HEATERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes gas-fired unit heaters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of gas-fired unit heater.
  - 1. Include rated capacities, operating characteristics, and accessories.
- B. Shop Drawings: For gas-fired unit heaters. Include plans, elevations, sections, and attachment details.
  - 1. Prepare by or under the supervision of a qualified professional engineer detailing fabrication and assembly of gas-fired unit heaters, as well as procedures and diagrams.
  - 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 wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, elevations, 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 equipment will be attached.
  - 2. Items penetrating roof and the following:
    - a. Vent and gas piping rough-ins and connections.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas-fired unit heaters 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. Fan Belts: One for each belt-driven fan size.

## 1.7 QUALITY ASSURANCE

- A. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace heat exchanger of gas-fired unit heater 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 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Lennox International, Inc.
  - 2. Modine Manufacturing Company.
  - 3. Reznor/Thomas & Betts Corporation.
  - 4. Sterling HVAC Products; Div. of Mestek Technology Inc.
  - 5. Trane; a brand of Ingersoll Rand.

## 2.2 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. Capacities and Characteristics: Refer to schedule on prints.

## 2.3 MANUFACTURED UNITS

- A. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.
- B. Gas Type: Design burner for natural gas having characteristics same as those of gas available at Project site.
- C. Type of Venting: Indoor, separated combustion, power vented.
- D. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.
  - 1. External Casings and Cabinets: Baked enamel over corrosion-resistant-treated surface.
  - 2. Discharge Louvers: Independently adjustable, horizontal blades.
- E. Accessories:
  - 1. Four-point suspension kit.
  - 2. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.
- F. Heat Exchanger: Aluminized steel.
- G. Burner Material: Aluminized steel with stainless-steel inserts.
- H. Propeller Unit Fan:
  - 1. Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.
  - 2. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.
- I. Motors:
  - 1. Enclosure Materials: Rolled steel.
  - 2. Efficiency: Premium efficient.
- J. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.
  - 1. Gas Control Valve: Single stage.
  - 2. Ignition: Electronically controlled electric spark with flame sensor.
  - 3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
  - 4. Vent Flow Verification: Differential pressure switch to verify open vent.
  - 5. Control transformer.
  - 6. High Limit: Thermal switch or fuse to stop burner.
  - 7. Thermostat: Devices and wiring are specified in Section 230900 "Instrumentation and Control for HVAC."
  - 8. Wall-Mounted Thermostat:
    - a. Single stage.
    - b. Fan on-off-automatic switch.

- c. 24-V ac.
- d. 50 to 90 deg F operating range.

K. Electrical Connection: Factory wire motors and controls for a single electrical connection.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install and connect gas-fired unit heaters and associated gas and vent features and systems according to NFPA 54, applicable local codes and regulations, and manufacturer's written instructions.

### 3.2 EQUIPMENT MOUNTING

- A. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to gas-fired unit heater, allow space for service and maintenance.
- C. Gas Piping: Comply with Section 231123 "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
- D. Vent Connections: Comply with Section 235100 "Breechings, Chimneys, and Stacks."
- E. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 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.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Verify bearing lubrication.
  3. Verify proper motor rotation.
  4. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- C. Gas-fired unit heater will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust initial temperature and humidity set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gas-fired unit heaters.

END OF SECTION 235533



## SECTION 260010 - BASIC ELECTRICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Work includes all electrical items and systems shown on the contract drawings and specified herein.
- B. Unless specifically dimensioned, the work shown on the drawings is diagrammatic, and is intended only to show general arrangement.
- C. Include in the work all accessories and devices necessary for the intended operation of any system, whether or not specifically shown or specified.

#### 1.2 STANDARDS OF QUALITY

- A. The specifications establish the standard of quality required, either by description or by references to brand name, name of manufacturers or manufacturer's model number.
- B. Where one product only is specifically identified by name of manufacturer's model number, the Contractor shall base his bid on the use of the name product. Where multiple names are used, the Contractor shall base his bid on the use of any of those products named.
- C. The Contractor may submit with his bid, the names of products which are proposed as substitutions for products named in specifications. Each proposed substitution shall be accompanied by a written sum of money to be added or deducted from his bid. The Owner reserves the sole right to accept or reject said substitutions with or without cause.
- D. When equipment and/or materials are proposed to be purchased from a manufacturer other than those specified, the Contractor shall provide complete data adequate for the Engineer's evaluation of the proposed substitution.
- E. When the equipment other than that specified is used, the Contractor shall be responsible for any extra cost of required revisions such as structural steel, concrete, electrical, piping, etc. Such additional costs shall be identified at the time such substitutions are proposed.

#### 1.3 SUMMARY

- A. This Section includes general administrative and procedural requirements for electrical installations.
  - 1. Submittals
  - 2. Maintenance Manuals
  - 3. Rough-ins
  - 4. Electrical Installations

#### 1.4 SUBMITTALS

- A. The Contractor shall review, approve and submit shop drawings, with promptness so as to cause no delay in his work or in that of others. No submissions will be accepted by the Engineer without the signed review and approval of the Contractor.
- B. The Contractor shall check and verify pertinent field measurements, quantities of equipment and materials required.
- C. Submittals shall be identified by reference to project, the drawings, sections of specifications, or equipment symbols to which they relate.
- D. Shop drawings, when required, shall include:
  - 1. Verification of information given in Contract Documents such as performance, dimensions, weight, materials, construction, types, models, manufacturer, etc.
  - 2. Equipment layouts drawn to scale as may be required.
  - 3. Wiring diagrams and schematics for equipment.
  - 4. Any special construction conditions.
  - 5. Other information/data as may be requested.
- E. All submittals shall identify the specific details of the product or assembly. All optional features being proposed shall be so noted, or the submittal will be rejected.
- F. Review is only for general conformance with the design concept of the project and general compliance with the information given in the contract documents. Any action shown is subject to the requirements of the plans and specification. Contractor is responsible for dimensions which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades; and the satisfactory performance of his work.
- G. For items being resubmitted, clearly identify changes made from the initial submittal requested by the Engineer. The Engineer will review only those changes requested and identified by the Contractor.

#### 1.5 MAINTENANCE MANUALS

- A. Prepare maintenance manuals including the following information for equipment items:
  - 1. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  - 2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.
  - 3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
  - 4. Servicing instructions and lubrication charts and schedules.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the project properly identified with names, model numbers, types, grades, compliance labels, and other information needed for identification.

## 1.7 PERMITS, FEES, AND CERTIFICATES OF APPROVAL

- A. Contractor shall acquire all permits and certificates.
- B. Contractor shall provide all labor and instruments required for tests and cleaning of systems.
- C. Whenever tests are required, three (3) copies of the test reports shall be submitted to the Engineer and (1) electronic copy.
- D. Tests may be observed by the Engineer or his representative. Notify the Engineer a minimum of three weeks in advance of the test dates.

## 1.8 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

- A. In the absence of specific instruction in the technical specifications, equipment and installation shall conform to the following applicable codes, standards and regulations, latest editions:
  - 1. American Society for Testing Materials (ASTM).
  - 2. American National Standard Institute (ANSI).
  - 3. Underwriter's Laboratories, Inc. (UL).
  - 4. American Welding Society Code (AWSC).
  - 5. Local Building, Electrical, and Fire Codes.
  - 6. National Electrical Code (NEC).
  - 7. Service Rules and Regulations of Local Electrical Utility Company.
  - 8. National Electrical Manufacturer's Association (NEMA).
  - 9. U.S. Department of Health & Human Services "HRS-M-HF" 84-1.
  - 10. Occupational Safety and Health Act (OSHA).
  - 11. National Fire Protection Association (NFPA).
  - 12. Americans with Disabilities Act (ADA).

## PART 2 - PRODUCTS - Not Used.

## PART 3 - EXECUTION

### 3.1 ROUGH-IN

- A. Verify final locations for rough-ins with field measurements and with requirements of the actual equipment to be connected.

### 3.2 ELECTRICAL INSTALLATIONS

- A. General: Sequence, coordinate, and integrate the various elements of electrical systems, materials, and equipment. Comply with the following requirements:
1. Coordinate electrical systems, equipment, and materials installation with other building components.
  2. Verify all dimensions by field measurements.
  3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations.
  4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
  5. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work. Give particular attention to large equipment requiring positioning prior to closing in the building.
  6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
  7. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
  8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
  9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
  10. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
  11. Install access panel or doors where units are concealed behind finished surfaces.
  12. Install systems, material, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
  13. Coordinate all electrical requirements with other trades and their shop drawings prior to installing conduit, wire, switches and breakers. Notify engineer of any discrepancies between document and actual supplied equipment.

### 3.3 CUTTING AND PATCHING

- A. General: Performing cutting and patching in accordance with the following requirements:
1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a. Uncover work to provide for installation of ill-timed work.
    - b. Remove and replace defective work.
    - c. Remove and replace work not conforming to requirements of the contract documents.
    - d. Remove samples of installed work as specified for testing.

- e. Upon written instruction from the Engineer, uncover and restore work to provide for Engineer observation of concealed work.

END OF SECTION 260010

## SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

#### 1.2 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

### PART 2 - PRODUCTS – Not Used.

### PART 3 - EXECUTION

#### 3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION 260500

## SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

#### 1.2 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

### PART 2 - PRODUCTS

#### 2.1 CONDUCTORS AND CABLES

- A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.
- B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

#### 2.2 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

#### 2.3 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.



## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Stranded for No. 12 AWG and larger, except VFC cable, which shall be extra flexible stranded.

### 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN-2-THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-2-THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-2-THWN-2, single conductors in raceway.
- G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

### 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

### 3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
  - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

### 3.5 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

### 3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.7 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly.

### 3.8 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements.
    - a. Transfer switches.
    - b. All 100A and above feeders.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- B. Test and Inspection Reports: Prepare a written report 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.
- C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

## SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes grounding and bonding systems and equipment.

#### 1.2 INFORMATIONAL SUBMITTALS

- A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
  - 1. Ground rods.
  - 2. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding 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. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NETA MTS.
      - 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
      - 2) Include recommended testing intervals.

#### 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA or an NRTL.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- 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 UL 467 for grounding and bonding materials and equipment.

### 2.2 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

### 2.3 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

### 2.4 GROUNDING ELECTRODES

- A. Ground Rods: Copper-clad steel, sectional type; 5/8 by 96 inches.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install stranded conductors for No. 8 AWG and larger unless otherwise indicated.
- B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- C. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

### 3.3 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- B. 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 No. 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 according to written instructions by manufacturer of splicing and termination kits.
- C. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the 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 No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.4 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
- C. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.5 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
  - 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
  - 2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

### 3.6 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. 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 a calibrated torque wrench according to manufacturer's written instructions.
  3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  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 the record of tests and observations. Include the 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.
- C. Grounding system will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.
- E. Report measured ground resistances that exceed the following values:
  1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
  2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
  3. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
  4. Substations and Pad-Mounted Equipment: 5 ohms.
  5. Manhole Grounds: 10 ohms.



- F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

## SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.

#### 1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70.

#### 1.4 COORDINATION

- A. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

### PART 2 - PRODUCTS

#### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 2. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 4. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
  - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
  - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
  - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  - 6. Toggle Bolts: All-steel springhead type.
  - 7. Hanger Rods: Threaded steel.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. 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.

- D. 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. 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.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements.
- C. Anchor equipment to concrete base.
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.

END OF SECTION 260529

## SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Boxes, enclosures, and cabinets.
4. Handholes and boxes for exterior underground cabling.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. IMC: Comply with ANSI C80.6 and UL 1242.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. FMC: Comply with UL 1; zinc-coated steel.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  1. Fittings for EMT:
    - a. Material: Die cast.
    - b. Type: Setscrew.

- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

- A. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- C. LFNC: Comply with UL 1660.
- D. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
- E. Fittings for LFNC: Comply with UL 514B.
- F. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.3 BOXES, ENCLOSURES, AND CABINETS

- A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- D. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- H. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- I. Gangable boxes are prohibited.
- J. Metal Floor Boxes:

1. Material: Cast metal
2. Type: Fully adjustable
3. Shape: Rectangular
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

K. Nonmetallic Floor Boxes: Nonadjustable

1. Listing and labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.4 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armorcast Products Company.
  - b. Carson Industries LLC.
  - c. NewBasis.
  - d. Oldcastle Precast, Inc.
  - e. Quazite: Hubbell Power System, Inc.
  - f. Synertech Moulded Products.
2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "TELEPHONE".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

## 2.5 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

## PART 3 - EXECUTION

### 3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Underground Conduit: RNC, Type EPC-40-PVC,.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: GRC.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.



### 3.2 INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- C. Complete raceway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Raceways Embedded in Slabs:
  - 1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
  - 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
  - 5. Change from ENT to GRC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for raceways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

- M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- S. Surface Raceways:
  - 1. Install surface raceway with a minimum 2-inch radius control at bend points.
  - 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.
- T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.
- U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service raceway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
- W. Expansion-Joint Fittings:
  - 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental

- temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
    - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    - d. Attics: 135 deg F temperature change.
  3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
  4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
  5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.
- X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
1. Use LFMC in damp or wet locations subject to severe physical damage.
  2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- Y. 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.
- Z. 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.
- AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- BB. Locate boxes so that cover or plate will not span different building finishes.
- CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

### 3.3 INSTALLATION OF UNDERGROUND CONDUIT

#### A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom for pipe less than 6 inches in nominal diameter.
2. Install backfill.
3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
  - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
  - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

### 3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, 24 inches below grade.
- E. 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.

- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

### 3.5 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."

### 3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.7 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

**SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING****PART 1 - GENERAL****1.1 SUMMARY****A. Section Includes:**

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

**PART 2 - PRODUCTS****2.1 SLEEVES****A. Wall Sleeves:**

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

**B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.****C. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.****2.2 SLEEVE-SEAL SYSTEMS****A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.**

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

## 2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

## 2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

## 2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
  - 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
  - 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
    - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint.
    - b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

### 3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### 3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544



## SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.

#### 1.2 QUALITY ASSURANCE

- A. Comply with ANSI A13.1 and IEEE C2.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

#### 1.3 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- D. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- E. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.

### 2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Colors for Cables Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

### 2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.
- B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.
- C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

- D. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- E. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- F. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of cable it identifies and to stay in place by gripping action.

## 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
- B. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeve with diameter sized to suit diameter of conductor it identifies and to stay in place by gripping action.
- C. Write-On Tags: Polyester tag, 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Labels for Tags: Self-adhesive label, machine-printed with permanent, waterproof, black ink recommended by printer manufacturer, sized for attachment to tag.

## 2.5 UNDERGROUND-LINE WARNING TAPE

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- B. Color and Printing:
  - 1. Comply with ANSI Z535.1 through ANSI Z535.5.
- C. Description:
  - 1. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.
  - 2. Overall Thickness: 5 mils.
  - 3. Foil Core Thickness: 0.35 mil.

4. Weight: 28 lb/1000 sq. ft.
5. 3-Inch Tensile According to ASTM D 882: 70 lbf, and 4600 psi.

## 2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Warning label and sign shall include, but are not limited to, the following legends:
  1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
  2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## 2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  1. Engraved legend with black letters on white face.
  2. Punched or drilled for mechanical fasteners.
  3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- B. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.
- C. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.
- G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.

### 3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot maximum intervals.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  - 1. Emergency Power.
  - 2. Power.
- C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.
  - 1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
    - a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.

- 3) Phase C: Blue.
- c. Colors for 480/277-V Circuits:
  - 1) Phase A: Brown.
  - 2) Phase B: Orange.
  - 3) Phase C: Yellow.
- d. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels with the conductor or cable designation, origin, and destination.
- F. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive, self-laminating polyester labels with the conductor designation.
- G. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
  - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
  - 1. Limit use of underground-line warning tape to direct-buried cables.
  - 2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
  - 1. Comply with 29 CFR 1910.145.
  - 2. Identify system voltage with black letters on an orange background.
  - 3. Apply to exterior of door, cover, or other access.
  - 4. 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.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label Stenciled legend 4 inches high.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  - 2. Equipment to Be Labeled:
    - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Switchboards.
    - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Emergency system boxes and enclosures.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.
    - i. Variable-speed controllers.
    - j. Power transfer equipment.
    - k. Power-generating units.
    - l. Light control panels.

END OF SECTION 260553



## SECTION 260923 - LIGHTING CONTROL DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Photoelectric switches.
2. Indoor occupancy sensors.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

### PART 2 - PRODUCTS

#### 2.1 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

## 2.2 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hubbell Building Automation, Inc.
  2. Leviton Manufacturing Co., Inc.
  3. Lightolier Controls.
  4. Lutron Electronics Co., Inc.
  5. Sensor Switch, Inc.
  6. Steinel
  7. Watt Stopper.
- B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
  1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Operation: 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.
  3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
  4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
  5. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
  7. Bypass Switch: Override the "on" function in case of sensor failure.
  8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
  2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot- high ceiling.
- D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch- high ceiling.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.
  4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- high ceiling.
  5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot- high ceiling in a corridor not wider than 14 feet.
- E. 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- minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch- high ceiling.

## 2.3 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hubbell Building Automation, Inc.
  2. Leviton Manufacturing Co., Inc.
  3. Lightolier Controls.
  4. Lutron Electronics Co., Inc.
  5. Sensor Switch, Inc.
  6. Steinel
  7. Watt Stopper.
- B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag OC:

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: Dual technology - PIR and ultrasonic.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

D. Wall-Switch Sensor Tag OC2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft.
2. Sensing Technology: Dual technology.
3. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Match the circuit voltage.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
9. Provide second relay for exhaust fan control.

## 2.4 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 SENSOR INSTALLATION

- 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 written instructions.

### 3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.3 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical 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.
- B. Perform the following 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. Lighting control devices will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors 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.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

## SECTION 262416 - PANELBOARDS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Enclosure types and details for types other than NEMA 250, Type 1.
    - b. Bus configuration, current, and voltage ratings.
    - c. Short-circuit current rating of panelboards and overcurrent protective devices.
    - d. Evidence of NRTL listing for series rating of installed devices.
    - e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
    - f. Time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.
  - 2. Wiring Diagrams: Power, signal, and control wiring.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data.
- B. Typed updated panelboard schedules for installation in panelboards.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency, and marked for intended location and application.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton – Cutler-Hammer
- B. Source Limitations: Obtain panelboards and power distribution components from a single manufacturer.
- C. Enclosures: Flush- or surface-mounted cabinets as shown on the floor plans.
1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Directory Card: Inside panelboard door, mounted in transparent card holder.
- D. Incoming Mains Location: Top or bottom depending on panel feeders.
- E. Phase, Neutral, and Ground Buses:
1. Base Bid: Hard-drawn copper, 98 percent conductivity.
  2. Alternate E1: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit breaker line connections.
- F. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Main and Neutral Lugs: Compression or Mechanical type.
  2. Ground Lugs and Bus Configured Terminators: Compression or Mechanical type.
  3. Feed-Through Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  4. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
  5. Subfeed (Double) Lugs: Compression or Mechanical type, suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.



- G. Service Equipment Label: NRTL labeled for use as service equipment for panelboards with one or more main service disconnecting and overcurrent protective devices.
- H. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- I. Panelboard Short-Circuit Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled NRTL. Include size and type of allowable upstream and branch devices, and listed and labeled for series-connected short-circuit rating by NRTL.

## 2.2 PERFORMANCE REQUIREMENTS

- A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

## 2.3 DISTRIBUTION PANELBOARDS

- A. Panelboards: NEMA PB 1, power and feeder distribution type.
- B. Mains: Circuit breaker or Lugs only and noted on the panel schedules.
- C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

## 2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- B. Mains: Circuit Breaker or Main Lugs only.
- C. Branch Overcurrent Protective Devices:
  - 1. 208Y120 Volt:
    - a. 15 amps through 70 amps: Plug-in circuit breakers, replaceable without disturbing adjacent units.
    - b. Over 70 amps: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
  - 2. 480Y277 Volt: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

## 2.5 DISCONNECT AND OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with series-connected rating 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. GFCI Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (30-mA trip).
3. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
4. Features and Accessories:
  - a. Standard frame sizes, trip ratings, and number of poles.
  - b. Lugs: Mechanical or Compression style, suitable for number, size, trip ratings, and conductor materials.
  - c. Application Listing: Appropriate for application; Type SWD for switching 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.
  - e. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
  - f. Handle Padlocking Device: Fixed attachment, for locking circuit breaker handle in on or off position.
  - g. Handle Clamp: Loose attachment, for holding circuit breaker handle in on position.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Receive, inspect, handle, store and install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 72 inches above finished floor, unless otherwise indicated.
- C. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- D. Install overcurrent protective devices and controllers not already factory installed.
  1. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below the floor for areas with accessible spaces below the finished floor.
- G. Arrange conductors in gutters into groups and bundled and loosely wrap with wire ties.

### 3.2 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads and incorporating Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and as noted on the drawings.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- C. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical.
  - 2. Correct malfunctioning units on site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
- D. Panelboards will be considered defective if they do not pass tests and inspections.

END OF SECTION 262416

## SECTION 262726 - WIRING DEVICES

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Weather-resistant receptacles.
4. Snap switches and wall-box dimmers.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

### PART 2 - PRODUCTS

#### 2.1 GENERAL WIRING-DEVICE REQUIREMENTS

- A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

#### 2.2 STRAIGHT-BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 5351 (single), CR5362 (duplex).
    - b. Hubbell; HBL5351 (single), HBL5352 (duplex).
    - c. Leviton; 5891 (single), 5352 (duplex).

- d. Pass & Seymour; 5361 (single), 5362 (duplex).

## 2.3 GFCI RECEPTACLES

### A. General Description:

1. Straight blade, feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

### B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; VGF20.
  - b. Hubbell; GFR5352L.
  - c. Pass & Seymour; 2095.
  - d. Leviton; 7590.

## 2.4 HAZARDOUS (CLASSIFIED) LOCATION RECEPTACLES

### A. Available Wiring Devices for Hazardous (Classified) Locations: Comply with NEMA FB 11 and UL 1010.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cooper Crouse-Hinds.
  - b. EGS/Appleton Electric.
  - c. Killark; Division of Hubbell Inc.

## 2.5 TWIST-LOCKING RECEPTACLES

### A. Single Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; CWL520R.
  - b. Hubbell; HBL2310.
  - c. Leviton; 2310.
  - d. Pass & Seymour; L520-R.

## 2.6 TOGGLE SWITCHES

### A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

## B. Switches, 120/277 V, 20 A:

## 1. Products: Subject to compliance with requirements, provide one of the following:

## 1) Single Pole:

- a) Cooper; AH1221.
- b) Hubbell; HBL1221.
- c) Leviton; 1221-2.
- d) Pass & Seymour; CSB20AC1.

## 2) Two Pole:

- a) Cooper; AH1222.
- b) Hubbell; HBL1222.
- c) Leviton; 1222-2.
- d) Pass & Seymour; CSB20AC2.

## 3) Three Way:

- a) Cooper; AH1223.
- b) Hubbell; HBL1223.
- c) Leviton; 1223-2.
- d) Pass & Seymour; CSB20AC3.

## 4) Four Way:

- a) Cooper; AH1224.
- b) Hubbell; HBL1224.
- c) Leviton; 1224-2.
- d) Pass & Seymour; CSB20AC4.

## C. Pilot-Light Switches, 20 A:

## 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Cooper; AH1221PL for 120 and 277 V.
- b. Hubbell; HBL1201PL for 120 and 277 V.
- c. Leviton; 1221-LH1.
- d. Pass & Seymour; PS20AC1RPL for 120 V, PS20AC1RPL7 for 277 V.

## 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

## 2.7 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

- C. LED Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.8 WALL PLATES

- A. Single and combination types shall match corresponding wiring devices.
  - 1. Plate-Securing Screws: Metal with head color to match plate finish.
  - 2. Material for Finished Spaces: 0.035-inch- thick, satin-finished, Type 302 stainless steel.
  - 3. Material for Unfinished Spaces: Galvanized steel.
  - 4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

## 2.9 FINISHES

- A. Device Color:
  - 1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
- B. Wall Plate Color: For plastic covers, match device color.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
  - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
  - a. Cut back and pigtail, or replace all damaged conductors.
  - b. Straighten conductors that remain and remove corrosion and foreign matter.
  - c. Pigtail existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.



### 3.2 GFCI RECEPTACLES

- A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

### 3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

END OF SECTION 262726

## SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
  - 1. Fusible switches.
  - 2. Nonfusible switches.
  - 3. Enclosures.

## 1.2 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
  - 1. Enclosure types and details for types other than NEMA 250, Type 1.
  - 2. Current and voltage ratings.
  - 3. Short-circuit current rating.
  - 4. UL listing for series rating of installed devices.
  - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports including the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
  - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

### 1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NFPA 70.

### 1.4 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
  - 2. Altitude: Not exceeding 6600 feet.

### 1.5 COORDINATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

## PART 2 - PRODUCTS

### 2.1 FUSIBLE AND NONFUSIBLE SWITCHES

- A. Available Manufacturers:
  - 1. Eaton Corporation; Cutler-Hammer Products.
  - 2. General Electric Co.; Electrical Distribution & Control Division.
  - 3. Siemens Energy & Automation, Inc.
  - 4. Square D/Group Schneider.
- B. Fusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Nonfusible Switch, 1200 A and Smaller: NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. 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; and labeled for copper and aluminum neutral conductors.
  - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

## 2.2 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
  - 1. Outdoor Locations: NEMA 250, Type 3R.
  - 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
  - 3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

## 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.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

### 3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section "Identification for Electrical Systems."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 26 Section "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Prepare for acceptance testing as follows:
  - 1. Inspect mechanical and electrical connections.
  - 2. Verify switch and relay type and labeling verification.
  - 3. Verify rating of installed fuses.
  - 4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.
- B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case 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. Infrared Scanning:
  - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Open or remove doors or panels so connections are accessible to portable scanner.
  - b. Instruments, Equipment and Reports:
    - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - 2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 262816

## SECTION 262913.03 - MANUAL AND MAGNETIC MOTOR CONTROLLERS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Combination full-voltage magnetic motor controllers.
  - 2. Enclosures.
  - 3. Accessories.
  - 4. Identification.

#### 1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. MCCB: Molded-case circuit breaker.
- C. MCP: Motor circuit protector.
- D. NC: Normally closed.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SCPD: Short-circuit protective device.

#### 1.4 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: For each type of magnetic controller.
  - 1. Include plans, elevations, sections, and mounting details.
  - 2. Indicate dimensions, weights, required clearances, and location and size of each field connection.

3. Wire Termination Diagrams and Schedules: Include diagrams for signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features. Differentiate between manufacturer-installed and field-installed wiring.
4. Include features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

C. Product Schedule: List the following for each enclosed controller:

1. Each installed magnetic controller type.
2. NRTL listing.
3. Factory-installed accessories.
4. Nameplate legends.
5. SCCR of integrated unit.
6. For each combination magnetic controller include features, characteristics, ratings, and factory setting of the SCPD and OCPD.
  - a. Listing document proving Type 2 coordination.
7. For each series-rated combination state the listed integrated short-circuit current (withstand) rating of SCPD and OCPDs by an NRTL acceptable to authorities having jurisdiction.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for magnetic controllers, 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.

## 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For magnetic controllers to include in operation and maintenance manuals.
  1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    - a. Routine maintenance requirements for magnetic controllers and installed components.

- b. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
- c. Manufacturer's written instructions for setting field-adjustable overload relays.
- d. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- e. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  - 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
  - 3. Indicating Lights: Two of each type and color installed.
  - 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
  - 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- B. If stored in areas subject to weather, cover controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 50 W.

#### 1.10 FIELD CONDITIONS

- A. Ambient Environment Ratings: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
  - 1. Ambient Temperature: Not less than 23 deg F (minus 5 deg C) and not exceeding 104 deg F (40 deg C).



2. Altitude: Not exceeding 6600 feet (2010 m) for electromagnetic and manual devices.
3. The effect of solar radiation is not significant.

## 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 use.
- B. UL Compliance: Fabricate and label magnetic motor controllers to comply with UL 508 and UL 60947-4-1.
- C. NEMA Compliance: Fabricate motor controllers to comply with ICS 2.
- D. Seismic Performance: Magnetic controllers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
  1. The term "withstand" means "the controller will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
  2. Component Importance Factor: 1.5.

### 2.2 COMBINATION FULL-VOLTAGE MAGNETIC MOTOR CONTROLLER

- A. Description: Factory-assembled, combination full-voltage magnetic motor controller consisting of the controller described in this article, indicated disconnecting means, SCPD and OCPD, in a single enclosure.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Eaton Corporation; Cutler-Hammer Products.
  2. General Electric Company; GE Industrial Systems.
  3. Siemens Energy and Automation; Industrial Products Division.
  4. Square D.
  5. Yaskawa.
- C. Standard: Comply with NEMA ICS 2, general purpose, Class A.
- D. Configuration: Nonreversing.
- E. Contactor Coils: Pressure-encapsulated type with coil transient suppressors when indicated.
  1. Operating Voltage: Manufacturer's standard, unless indicated.
- F. Control Power:

1. For on-board control power, obtain from line circuit or from integral CPT. The CPT shall have capacity to operate integral devices and remotely located pilot, indicating, and control devices.
  - a. Spare CPT Capacity as Indicated on Drawings: 50 VA.
- G. Overload Relays:
  1. Thermal Overload Relays:
    - a. Inverse-time-current characteristic.
    - b. Class 10 tripping characteristic.
    - c. Heaters in each phase shall be matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    - d. Ambient compensated.
    - e. Automatic resetting.
  2. Solid-State Overload Relay:
    - a. Switch or dial selectable for motor-running overload protection.
    - b. Sensors in each phase.
    - c. Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
- H. Class II ground-fault protection shall comply with UL 1053 to interrupt low-level ground faults. The ground-fault detection system shall include circuitry that will prevent the motor controller from tripping when the fault current exceeds the interrupting capacity of the controller. Equip with start and run delays to prevent nuisance trip on starting, and a trip indicator.
- I. Digital communication module, using RS-485 Modbus, RTU protocol, 2 to 4-wire connection to host devices with a compatible port to transmit the following to the LAN:
  1. Instantaneous rms current each phase, and 3-phase average.
  2. Voltage: L-L for each phase, L-L 3-phase average, L-N each phase and L-N 3-phase average - rms.
  3. Active Energy (kWh): 3-phase total.
  4. Power Factor: Each phase and 3-phase total.
- J. Fusible Disconnecting Means:
  1. NEMA KS 1, heavy-duty, horsepower-rated, fusible switch with clips or bolt pads to accommodate indicated fuses.
  2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- K. Nonfusible Disconnecting Means:
  1. NEMA KS 1, heavy-duty, horsepower-rated, nonfusible switch.
  2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
- L. MCP Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents, instantaneous-only circuit breaker with front-mounted, field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
2. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

M. MCCB Disconnecting Means:

1. UL 489 and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse-time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
2. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
3. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.

## 2.3 ENCLOSURES

- A. Comply with NEMA 250, type designations as indicated on Drawings, complying with environmental conditions at installed location.
- B. The construction of the enclosures shall comply with NEMA ICS 6.
- C. Controllers in hazardous (classified) locations shall comply with UL 1203.

## 2.4 ACCESSORIES

- A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.
  1. Push Buttons, Pilot Lights, and Selector Switches: Standard-duty, except as needed to match enclosure type. Heavy-duty or oil-tight where indicated in the controller schedule.
    - a. Push Buttons: As indicated in the controller schedule.
    - b. Pilot Lights: As indicated in the controller schedule.
  2. Elapsed Time Meters: Heavy duty with digital readout in hours resettable.
  3. Meters: Panel type, 2-1/2-inch (64-mm) minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.
- B. Motor protection relays shall be with solid-state sensing circuit and isolated output contacts for hardwired connections.
  1. Phase-failure.
  2. Phase-reversal, with bicolor LED to indicate normal and fault conditions. Automatic reset when phase reversal is corrected.
  3. Under/overvoltage, operate when the circuit voltage reaches a preset value, and drop out when the operating voltage drops to a level below the preset value. Include adjustable time-delay setting.

- C. Breather assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- D. Space heaters, with NC auxiliary contacts, to mitigate condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- E. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.

## 2.5 IDENTIFICATION

- A. Controller Nameplates: As described in Section 260553 "Identification for Electrical Systems," for each compartment, mounted with corrosion-resistant screws.
- B. Arc-Flash Warning Labels:
  - 1. Comply with requirements in Section 260573.19 "Arc-Flash Hazard Analysis." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis.
  - 2. Comply with requirements in Section 260553 "Identification for Electrical Systems." Produce a 3.5-by-5-inch (89-by-127-mm) self-adhesive equipment label for each work location included in the analysis. Labels shall be machine printed, with no field-applied markings.
    - a. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
      - 1) Location designation.
      - 2) Nominal voltage.
      - 3) Flash protection boundary.
      - 4) Hazard risk category.
      - 5) Incident energy.
      - 6) Working distance.
      - 7) Engineering report number, revision number, and issue date.
    - b. Labels shall be machine printed, with no field-applied markings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and space conditions for compliance with requirements for motor controllers, their relationship with the motors, and other conditions affecting performance of the Work.

### 3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Wall-Mounted Controllers: Install magnetic controllers on walls with tops at uniform height indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems" unless otherwise indicated.
- C. Maintain minimum clearances and workspace at equipment according to manufacturer's written instructions and NFPA 70.
- D. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.
- E. Setting of Overload Relays: Select and set overloads on the basis of full-load current rating as shown on motor nameplate. Adjust setting value for special motors as required by NFPA 70 for motors that are high-torque, high-efficiency, and so on.

### 3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
  - 1. Comply with the provisions of NFPA 70B, "Testing and Test Methods" Chapter.
  - 2. Visual and Mechanical Inspection:
    - a. Compare equipment nameplate data with drawings and specifications.
    - b. Inspect physical and mechanical condition.
    - c. Inspect anchorage, alignment, and grounding.
    - d. Verify the unit is clean.
    - e. Inspect contactors:
      - 1) Verify mechanical operation.
      - 2) Verify contact gap, wipe, alignment, and pressure are according to manufacturer's published data.

- f. Motor-Running Protection:
    - 1) Verify overload element rating is correct for its application.
    - 2) If motor-running protection is provided by fuses, verify correct fuse rating.
  - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
    - 1) Use a low-resistance ohmmeter. Compare bolted connection resistance values with values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
    - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method according to manufacturer's published data or NETA ATS Table 100.12. Bolt-torque levels shall be according to manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
  - h. Verify appropriate lubrication on moving current-carrying parts and on moving and sliding surfaces.
3. Electrical Tests:
- a. 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. Insulation-resistance values shall be according to manufacturer's published data or NETA ATS Table 100.1. In the absence of manufacturer's published data, use Table 100.5. Values of insulation resistance less than those of this table or manufacturer's recommendations shall be investigated and corrected.
  - b. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
  - c. Test motor protection devices according to manufacturer's published data.
  - d. Test circuit breakers as follows:
    - 1) Operate the circuit breaker to ensure smooth operation.
    - 2) For adjustable circuit breakers, adjust protective device settings according to the coordination study. Comply with coordination study recommendations.
  - e. Perform operational tests by initiating control devices.
- F. Prepare test and inspection reports.

### 3.5 SYSTEM FUNCTION TESTS

- A. System function tests shall prove the correct interaction of sensing, processing, and action devices. Perform system function tests after field quality control tests have been completed and all components have passed specified tests.

1. Develop test parameters and perform tests for the purpose of evaluating performance of integral components and their functioning as a complete unit within design requirements and manufacturer's published data.
  2. Verify the correct operation of interlock safety devices for fail-safe functions in addition to design function.
  3. Verify the correct operation of sensing devices, alarms, and indicating devices.
- B. Motor controller will be considered defective if it does not pass the system function tests and inspections.
- C. Prepare test and inspection reports.

### 3.6 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain switchgear.

END OF SECTION 262913.03

## SECTION 265100 - INTERIOR LIGHTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Interior lighting fixtures, lamps, and ballasts.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Lighting fixture supports.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast, including BF.
  - 4. Energy-efficiency data.
  - 5. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
- B. Shop Drawings: For nonstandard or custom lighting fixtures. 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.
- C. Installation instructions.

## 1.3 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
  - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
  - 2. Complete schedule at end of specification.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.



1. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
2. LED Modules: 1 for every 25 of each type and rating installed. Furnish at least one of each type.

## 1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## 1.7 WARRANTY

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Emergency Lighting Unit Batteries: 10 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  2. Warranty Period for Batteries: Seven years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.
- B. Special Warranty for LEDs and Drivers: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide product indicated on Drawings.

## 2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.
- D. 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.
- E. Diffusers and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass unless otherwise indicated.
- F. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
  - 1. Label shall include the following lamp and ballast characteristics:
    - a. "USE ONLY" and include specific lamp type.
    - b. LED information, manufacturer, wattage.
    - c. CCT and CRI for all luminaires.

## 2.3 EMERGENCY LED POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
  - 1. Emergency Connection: Operate LED continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to fixture ballast.
  - 2. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 3. Battery: Sealed, maintenance-free, nickel-cadmium type.

4. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
5. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

## 2.4 LED DRIVER

- A. High efficiency.
- B. If installed outside, shall be fully encased in potting for moisture resistance.

## 2.5 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
  2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

## 2.6 LEDs

- A. High-brightness LEDs mounted to a metal core circuit board.
- B. Provide 3500 K color temperature, unless otherwise noted on drawings.
- C. Provide color accuracy (CRI) 80.

## 2.7 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with 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 fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Lighting fixtures:
  - 1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
  - 2. Install lamps in each luminaire.
- B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.
- C. Lay-in Ceiling Lighting Fixtures Supports: Use grid as a support element.
  - 1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least one independent support rod or wire from structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- D. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.
- E. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 IDENTIFICATION

- A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

### 3.4 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

END OF SECTION 265100

## SECTION 265600 - EXTERIOR LIGHTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Exterior luminaires with LEDs light source and drivers.
  - 2. Poles.
  - 3. Utility company rebate forms.

## 1.2 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

- A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.
- B. Live Load: Single load of 500 lbf, distributed as stated in AASHTO LTS-4.
- C. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.
- D. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.
  - 1. Wind speed for calculating wind load for poles 50 feet or less in height is 70 mph.

## 1.3 SUBMITTALS

- A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
  - 2. Details of attaching luminaires and accessories.
  - 3. Details of installation and construction.
  - 4. Luminaire materials.
  - 5. Drivers, including energy-efficiency data.
  - 6. LEDs, including life, output, and energy-efficiency data.
  - 7. Materials, dimensions, and finishes of poles.
  - 8. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
  - 9. Anchor bolts and bolt circle pattern for poles.
- B. Shop Drawings:
  - 1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
  - 2. Wiring Diagrams: Power wiring.

- C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.
- D. Qualification Data: For agencies providing photometric data for lighting fixtures.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For luminaires to include in emergency, operation, and maintenance manuals.
- G. Warranty: Special warranty specified in this Section.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with IEEE C2, "National Electrical Safety Code."
- C. Comply with NFPA 70.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.
- B. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

#### 1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period. Manufacturer may exclude lightning damage, hail damage, vandalism, abuse, or unauthorized repairs or alterations from special warranty coverage.
  - 1. Warranty Period for Luminaires: Five years from date of Substantial Completion.
  - 2. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

#### 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Two complete luminaires, identical to the installed perimeter luminaires.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Refer to Lighting Schedule on Sheet E-100.

### 2.2 LUMINAIRES, GENERAL REQUIREMENTS

- A. The Luminaire shall be designed and manufactured in the United States. Global components will be allowed provided greater than 50 percent of the parts and labor are sourced in the United States.
- B. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.
- C. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.
- D. Metal Parts: Free of burrs and sharp corners and edges.
- E. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.
- F. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.
- G. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.
- H. Exposed Hardware Material: Stainless steel.
- I. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- J. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- K. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.



## 2.3 OPTICAL REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Impact resistant polycarbonate remote phosphor plate with a thickness of at least 0.08 inches.
2. The remote phosphor plate shall meet or exceed the EN 62262 impact test with a rating of IK07 or better.
3. The polycarbonate remote phosphor shall meet or exceed the ASTM G154 Cycle 1 UV stability tests.
4. A diffuse, highly reflective mixing chamber with a reflectivity of  $\geq 97\%$ .
5. The optical system shall meet or exceed an IP65 rating.

## 2.4 PHOTOMETRIC REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Nominal CCT of 3000K, adjustable with different remote phosphor plates.
2. Typical CRI of  $\geq 70$ , adjustable with different remote phosphor plates
3. Minimum initial luminaire efficacy of 90 lm/W (3000K 80CRI)
4. Two adjustable light arrays from 0 to 30 degrees
5. Lumen output  $> 20,000$  (3000K, 80CRI)
6. The luminaire shall be registered with the US Department of Energy Lighting Facts program.

## 2.5 ELECTRICAL SYSTEM REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Power supply rated at IP65 or better.
2. Luminaire shall have an integrated universal 480 VAC input.
3. Operating temperature of  $-40^{\circ}\text{C}$  to  $+45^{\circ}\text{C}$  or wider.
4. UL certified power supply providing constant current with a voltage below 60 volts DC.
5. THD (Total Harmonic Distortion) from the power supply shall be 10% or lower.

## 2.6 LIGHT ENGINE REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. L70 lumen maintenance shall exceed 96,000 hours.
2. LED LM-80 data must show  $< 0.1\%$  decrease in output after 10,000 hours.
3. The light output shall have 5 or lower SDCM (Standard Deviation of Color Matching) consistency from fixture to fixture and over the L70 life of the product.
4. Polycarbonate based remote phosphor plate with a typical lm/Wrad efficacy of 230 or better.
5. Highly reflective, diffuse mixing chamber with a diffuse reflectivity rating of 97% or greater.
6. Metal core LED circuit board.

## 2.7 MECHANICAL REQUIREMENTS

### A. Luminaires shall meet or exceed the following:

1. Effective Projected Area (EPA) not to exceed 3.50.
2. A weight  $\leq$  50 pounds (not including additional controls or 480VAC option).
3. Normal operation range from -40 C to +45C or wider.
4. Housing constructed of die cast aluminum, extruded aluminum and stainless steel.
5. Cast parts shall be finished in a corrosion resistant polyester powder paint.
6. Internally mounted drivers.
7. Corrosion resistant fasteners.
8. Integrated heat sink fins designed to reduce water and debris collection.
9. Support for both vertical and horizontal pipe mounting, including adjustment from -5 to +95 degrees.
10. A bolt-type slip fit mount should accept 2.5 to 2.0 inch OD pipes.
11. Optional custom paint colors.

## PART 3 - EXECUTION

### 3.1 LUMINAIRE INSTALLATION

#### A. Fasten luminaire to structural supports.

1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

#### B. Adjust luminaires that require field adjustment or aiming.

1. Contractor shall coordinate aiming of the newly installed luminaires during construction with MDOC and MDTMB staff. Contractor shall include up to three aiming iterations.
2. Preliminary aiming of fixtures will occur on the day of installation.
3. Final aiming of fixtures shall occur after normal working hours during a period of darkness. The aiming shall be scheduled one week in advance with MDOC and MDTMB staff. MDOC and MDTMB staff will be present during aiming operations to confirm proper aiming of each fixture.
4. Corrective aiming of fixtures as required to ensure proper coordination with newly installed cameras shall occur after installation and start-up of camera equipment.

### 3.2 CORROSION PREVENTION

- #### A. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

### 3.3 GROUNDING

- #### A. Ground metal poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

1. Install grounding electrode for each pole, unless otherwise indicated.
  2. Install grounding conductor pigtail in the base for connecting luminaire to grounding system.
- B. Ground nonmetallic poles and support structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."
1. Install grounding electrode for each pole.
  2. Install grounding conductor and conductor protector.
  3. Ground metallic components of pole accessories and foundations.

### 3.4 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
- C. Contractor shall provide (2) night aiming sessions.
- D. Contractor shall provide (1) aiming session after CCTV camera installation.
- E. Verify that new system is fully operational and compatible with the existing photocell and/or time clock controls.

### 3.7 UTILITY COMPANY LIGHTING REBATES

- A. Contractor shall coordinate with the local Electric Utility Company for all available rebates, to be paid to the Owner, for the replacement of HID luminaires with LED luminaires as part of this project.
- B. Provide the utility company with all required documentation including wattage reduction, luminaire specification sheets, purchase invoices, sample Owner utility bill and W-9 forms.
- C. Contractor shall complete rebate application forms and submit them along with all required documentation to utility company upon project completion.

END OF SECTION 265600