



HALEY WARD®

## PROJECT MANUAL

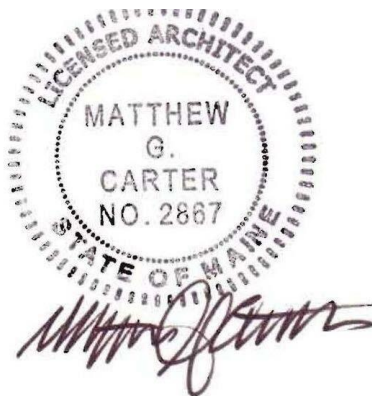
### CONNOR SCHOOL RENOVATIONS

1581 Van Buren Road | Connor Township, Maine

**Division of Planning, Design & Construction**

**Bureau of General Services**

77 State House Station | Augusta, Maine 04333-0077



APRIL 23, 2025

JN: 10377.028

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**PREPARED BY:**

**Haley Ward, Inc.**

One Merchants Plaza, Suite 701 | Bangor, ME 04401



**PROJECT MANUAL**  
**FOR**  
**CONNOR SCHOOL RENOVATIONS**  
**APRIL 2025**

<b>OWNER</b>	<b>CONTACT INFORMATION</b>	
Division of Planning, Design & Construction Bureau of General Services 77 State House Station 111 Sewall Street, 4 <sup>th</sup> Floor Augusta, ME 04333	Name:	John Kenney Ph.D., P.E.
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	Cell:	
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<b>CONTRACTOR</b>	<b>CONTACT INFORMATION</b>	
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	Title:	
	Tel:	
	Fax:	
	Cell:	
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**00 11 13**  
**Notice to Contractors**

**Connor School Renovations**

PT 3403

*The work of this project will consist of renovations to the Connor School located at 1581 Van Buren Road, Connor Township, Maine. Renovations shall include parking lot and site renovations, the drilling of a new well, new fencing, new site lighting, new sidewalks, an office and vestibule renovation/addition, a new water heater, mechanical upgrades and improvements, floor drain improvements, new mechanical control systems, new interior lighting systems, the replacement of electrical main distribution panels and sub panels, and the renovation of existing fire alarm systems.*

The contract shall designate the Substantial Completion Date on or before *06 March 2026*, and the Contract Final Completion Date on or before *31 March 2026*.

1. Submit bids on a completed Contractor Bid Form (section 00 41 13), provided in the Bid Documents, include bid security when required, and scan each item as an attachment to an email addressed to: BGS.Architect@Maine.gov, so as to be received no later than **1:30 p.m. on 23 May 2025**. The email subject line shall be marked "**Bid for Connor School Renovations**".

Bid submissions will be opened and read aloud at **2:00 p.m.** on the date noted above at the Bureau of General Services office, accessible as a video conference call. Those who wish to participate in the call must submit a request for access to BGS.Architect@Maine.gov.

Any bid received after the noted time will not be considered a valid bid and will remain unopened. Any bid submitted by any other means will not be considered a valid bid. In certain circumstances, the Bureau of General Services may require the Bidder to surrender a valid paper copy of the bid form or the bid security document. The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.

2. Questions and comments on the *bid opening process* shall be addressed to: Division of Planning, Design & Construction, Bureau of General Services, 77 State House Station, Augusta, Maine 04333-0077, BGS.Architect@Maine.gov.
3. Questions and comments regarding the *project* design specifications or drawings shall be directed in writing to the Consultant during the bid period prior to the question and comment deadline of 5:00 p.m. on *16 May 2025*.

*Haley Ward, Inc.*  
*Jared Merry, P.E.*  
*jerry@haleyward.com*  
*or*  
*Matthew Carter, AIA*  
*mcarter@haleyward.com*

**00 11 13**  
**Notice to Contractors**

4. ☒ Bid security is required on this project.

The Bidder shall include a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with the completed bid form submitted to the Owner. The Bid Bond form is available on the BGS website.

*or*

- ☐ Bid security is not required on this project.

5. ☒ Performance and Payment Bonds are required on this project.

If noted above as required, or if any combination of Base Bid and Alternate Bids amounts selected in the award of the contract exceeds \$125,000.00, the selected Contractor shall furnish a 100% contract Performance Bond (section 00 61 13.13) and a 100% contract Payment Bond (section 00 61 13.16) in the contract amount to cover the execution of the Work. Bond forms are available on the BGS website.

*or*

- ☐ Performance and Payment Bonds are not required on this project.

6. Filed Sub-bids *are not required* on this project.

7. ☐ Pre-qualified General Contractors are utilized on this project.

*or*

- ☒ Pre-qualified General Contractors are not utilized on this project.

8. ☒ An on-site pre-bid conference ( ☐ *mandatory* or ☒ *optional* ) will be conducted for this project. The pre-bid conference is intended for General Contractors. Subcontractors and suppliers are welcome to attend. Contractors who arrive late or leave early for a mandatory meeting may be prohibited from participating in this meeting and bidding.

*Tuesday, 29 April 2025 @ 2:00 p.m.*

*Connor Consolidated School*

*1581 Van Buren Road*

*Connor Township, ME 04736-6118*

*or*

- ☐ An on-site pre-bid conference will not be conducted for this project.

9. Bid Documents - full sets only - will be available on or about 22 April 2025 and may be obtained for a \$100 registration fee from:

*Haley Ward, Inc.*

*One Merchants Plaza, Suite 701*

*Bangor, ME 04401*

*(207) 989-4824*



**00 11 13**  
**Notice to Contractors**

10. Bid Documents may be examined at:

*AGC Maine*

*188 Whitten Road, Augusta, ME 04330*

*207-622-4741*

*Construction Summary*

*734 Chestnut Street, Manchester, NH 03104*

*603-627-8856*

**00 21 13**  
**Instructions to Bidders**

**1. Bidder Requirements**

- 1.1 A bidder is a Contractor which is evidently qualified, or has been specifically pre-qualified by the Bureau of General Services, to bid on the proposed project described in the Bid Documents.
- 1.2 Contractors and Subcontractors bidding on projects that utilize Filed Sub-bids shall follow the requirements outlined in these Bid Documents for such projects. See Section 00 22 13 for additional information.
- 1.3 Contractors and Subcontractors are not eligible to bid on the project when their access to project design documents prior to the bid period distribution of documents creates an unfair bidding advantage. Prohibited access includes consultation with the Owner or with design professionals engaged by the Owner regarding cost estimating, constructability review, or project scheduling. This prohibition to bid applies to open, competitive bidding or pre-qualified contractor bidding or Filed Sub-bidding. The Bureau may require additional information to determine if the activities of a Contractor constitute an unfair bidding advantage.
- 1.4 Each bidder is responsible for becoming thoroughly familiar with the Bid Documents prior to submitting a bid. The failure of a bidder to review evident site conditions, to attend available pre-bid conferences, or to receive, examine, or act on addenda to the Bid Documents shall not relieve that bidder from any obligation with respect to their bid or the execution of the work as a Contractor.
- 1.5 Prior to the award of the contract, General Contractor bidders or Filed Sub-bidders may be required to provide documented evidence to the Owner or the Bureau showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- 1.6 The selected General Contractor bidder will be required to provide proof of insurance before a contract can be executed.
- 1.7 Contracts developed from this bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- 1.8 By submitting a bid the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Director of the Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.
- 1.9 The Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

**00 21 13**  
**Instructions to Bidders**

- 1.10 The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.
2. Authority of Owner
  - 2.1 The Owner reserves the right to accept or reject any or all bids as may best serve the interest of the Owner.
  - 2.2 Subject to the Owner's stated right to accept or reject any or all bids, the Contractor shall be selected on the basis of the lowest dollar value of an acceptable Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications the Owner determines may best serve the interests of the Owner. An acceptable bid is a duly submitted bid from a responsive and responsible bidder.
  - 2.3 The Owner reserves the right to require Bid Bonds or Performance and Payment Bonds for any project of any contract value.
3. Submitting Bids and Bid Requirements
  - 3.1 Each bid shall be submitted on the forms provided in the Bid Documents.
  - 3.2 Each bid shall be valid for a period of thirty calendar days following the Project bid closing date and time. The bid expiration date may be extended in unusual circumstances by mutual consent of the Bidder and the Owner. The bid amount shall not be modified due to the bid expiration date extension.
  - 3.3 Any provision contained in a bid which shows cost escalation, or any modification of schedule or other requirements shall not be accepted. Such a provision causes the bid to be invalid, or, at the discretion of the Owner and BGS, that element of the bid submission may be disregarded for the purpose of awarding the contract without that provision.
  - 3.4 Bidders shall include a Bid Bond or other approved bid security with the bid form submitted to the Owner when the bid form indicates such bid security is required. The bond value shall be 5% of the bid amount. The form of bond is shown in section 00 43 13.
  - 3.5 Bidders recognize that inclusion of contract bonds and the cost of those bonds is dependent on the awarded contract dollar value. Therefore, a Base Bid, or any combination of Base Bid plus Alternate Bids, as well as other limited cost modifications, resulting in a contract award shall include the cost of Performance and Payment Bonds in the submitted bid amount when the construction contract value is over \$125,000.00. Similarly, the cost of Performance and Payment Bonds is excluded in the submitted bid amount when the construction contract value is \$125,000.00 or less unless bonds are specifically required by the Bid Documents. When required for the project, the selected Contractor shall provide these bonds before a contract can be executed, pursuant to 14 M.R.S.A., Section 871, Public Works Contractors' Surety Bond Law of 1971, subsection 3. The form of bonds is shown in section 00 61 13.13 and 00 61 13.16.

**00 21 13**  
**Instructions to Bidders**

- 3.6 Bidders may modify bids in writing, by the same means as the original bid submission, prior to the bid closing time. Such written amendments shall not disclose the amount of the initial bid. If so disclosed, the entire bid is considered invalid.
- 3.7 Bidders implicitly acknowledge all Addenda issued when they submit the bid form. By usual practice the Consultant shall not issue Addenda less than 72 hours prior to the bid closing time, to allow ample time for bidders to incorporate the information. However, some information, such as extending the bid due date and time, may be issued with shorter notice. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- 3.8 A bid may be withdrawn without penalty if a written request by the bidder is presented to the Owner prior to the bid closing time. Such written withdrawal requests are subject to verification as required by the Bureau.
- A bid may be withdrawn without penalty after the bid closing time if, in the determination of the Bureau, evidence provided by the Contractor shows an apparent unintended error such as a miscalculation, or an erroneous number on estimating documents, was the cause of an inaccurate bid. The Bureau may allow withdrawal in consideration of the bid bond or, without utilizing a bid bond, if the Bureau considers documented evidence provided by the Contractor shows factual errors had been made on the bid form.
- 3.9 In the event State of Maine Offices unexpectedly close on the published date of a public bid opening in the location of that bid opening, prior to the time of the scheduled deadline, the new deadline for the public bid opening will be the following business day at the originally scheduled hour of the day, at the original location. Official closings are posted on the State of Maine government website.
- 3.10 The Owner may require, in a Notice of Intent to Award letter to the apparent low bidder, a Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers as both a demonstration of capability of the Bidder and as a condition of award.
- 3.11 Projects which require a State of Maine wage determination will include that schedule as part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.12 Projects which require compliance with the Davis-Bacon Act are subject to the regulations contained the Code for Federal Regulations and the federal wage determination which is made a part of the Bid Documents. See section 00 73 46, if such rates are required.
- 3.13 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.

**00 41 13**  
**Contractor Bid Form**

**Connor School Renovations**

PT3403

Bid Form submitted by: *email only to email address below*

Bid Administrator:

*John Kenney, Ph.D., P.E.*

*Director Division of Planning, Design & Construction*

BGS.Architect@Maine.gov

Bureau of General Services

111 Sewall Street, Cross State Office Building, 4th floor

77 State House Station

Augusta, Maine 04333-0077

Bidder:

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

Printed name and  
title: \_\_\_\_\_

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

Mailing address: \_\_\_\_\_

City, state, zip code: \_\_\_\_\_

Phone number: \_\_\_\_\_

Email address: \_\_\_\_\_

State of  
incorporation,  
if a corporation: \_\_\_\_\_

List of all partners,  
if a partnership: \_\_\_\_\_

The Bidder agrees, if the Owner offers to award the contract, to provide any and all bonds and certificates of insurance, as well as Schedule of Values, Project Schedule, and List of Subcontractors and Suppliers if required by the Owner, and to sign the designated Construction Contract within twelve calendar days after the date of notification of such acceptance, except if the twelfth day falls on a State of Maine government holiday or other closure day, or a Saturday, or a Sunday, in which case the aforementioned documents must be received before 12:00 noon on the first available business day following the holiday, other closure day, Saturday, or Sunday.

As a guarantee thereof, the Bidder submits, together with this bid, a bid bond or other acceptable instrument as and if required by the Bid Documents.

**00 41 13**  
**Contractor Bid Form**

1. The Bidder, having carefully examined the *Connor School Renovation* Project Manual dated 22 April 2025, prepared by *Haley Ward, Inc.*, as well as Specifications, Drawings, and any Addenda, the form of contract, and the premises and conditions relating to the work, proposes to furnish all labor, equipment and materials necessary for and reasonably incidental to the construction and completion of this project for the **Base Bid** amount of:

\$ \_\_\_\_\_ .00

2. Allowances *are included* on this project.  
*Bid amount above includes the following Allowances*

1 Allowance #1: Excess Utility Allowance	\$ <u>63,500.00</u>
2 Allowance #2: Construction Testing Allowance	\$ <u>10,000.00</u>
3 Not Used	\$ <u>0.00</u>
4 Not Used	\$ <u>0.00</u>

3. Alternate Bids *are not included* on this project.  
*No Alternate Bids*  
Any dollar amount line below that is left blank by the Bidder shall be read as a bid of **\$0.00**.

1 Not Used	\$ _____ <u>.00</u>
2 Not Used	\$ _____ <u>.00</u>
3 Not Used	\$ _____ <u>.00</u>
4 Not Used	\$ _____ <u>.00</u>

4. Bid security *is required* on this project.  
If noted above as required, or if the Base Bid amount exceeds \$125,000.00, the Bidder shall include with this bid form a satisfactory Bid Bond (section 00 43 13) or a certified or cashier's check for 5% of the bid amount with this completed bid form submitted to the Owner.
5. Filed Sub-bids *are not required* on this project.  
If noted above as required, the Bidder shall include with this bid form a list of each Filed Sub-bidder selected by the Bidder on the form provided (section 00 41 13F).

**00 43 13**  
**Contractor Bid Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of five percent of the bid amount, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns, signed this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, or State of Maine, to a certain bid, attached hereto and hereby made a part hereof, to enter into a contract in writing, for the construction of insert name of project as designated in the contract documents

Now therefore:

If said bid shall be rejected, or, in the alternate,

If said bid shall be accepted and the principal shall execute and deliver a contract in the form of contract attached hereto, properly completed in accordance with said bid, and shall furnish a bond for the faithful performance of said contract, and for the payment of all persons performing labor or furnishing material in connection therewith, and shall in all other respects perform the agreement created by the acceptance of said bid, then this obligation shall be void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time within which the Obligee may accept such bid and said Surety does hereby waive notice of any such extension.

**00 43 13**  
**Contractor Bid Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the first specified bid due date, or subsequent bid due date revised by addendum.

**Contractor**

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

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

**Surety**

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

*insert name and title*

*insert company name*

*insert address*  
*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.



## State of Maine CONSTRUCTION CONTRACT

### Large Construction Project

*This form is used when the Contract value is \$50,000 or greater.  
The Project Manual, Specifications and Drawings, and any Addenda are considered part of this Contract.*

Agreement entered into by and between the contracting entity name hereinafter called the **Owner** and Contractor company name hereinafter called the **Contractor**.

BGS Project No.: number assigned by BGS

Other Project No.: \_\_\_\_\_

For the following Project: title of project as shown on bid documents at facility or campus name, municipality, Maine.

The Specifications and the Drawings have been prepared by Consultant firm name, acting as Professional-of-Record and named in the documents as the Consultant Architect or Engineer.

The *Owner* and *Contractor* agree as follows:

#### ARTICLE 1 COMPENSATION AND PAYMENTS

**1.1** The Owner shall pay the Contractor to furnish all labor, equipment, materials and incidentals necessary for the construction of the Work described in the Specifications and shown on the Drawings the Contract Amount as shown below.

Base Bid	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<u>Alternate Bid number and name or "no Alternates"</u>	<u>\$0.00</u>
<b>Total Contract Amount</b>	<b><u>\$0.00</u></b>

**1.2** The Contractor's requisition shall contain sufficient detail and supporting information for the Owner to evaluate and support the payment requested.

**1.2.1** Payments are due and payable twenty-five working days from the date of receipt of a Contractor requisition which is approved by the Owner.

**1.2.2** Provisions for late payments are governed by 5 M.R.S. Chapter 144, *Payment of Invoices Received from Business Concerns*, and interest shall be calculated at 1% per month.

#### ARTICLE 2 COMMENCEMENT AND COMPLETION DATES

**2.1** The Work of this Contract shall commence no sooner than the date this document is executed by the approval authority, or a subsequent date designated in the contract documents.

**2.2** The Substantial Completion Date shall be \_\_\_\_\_.

**2.3** The Work of this Contract shall be completed on or before the Contract Final Completion Date of \_\_\_\_\_.

**2.4** The Contract Expiration Date shall be \_\_\_\_\_. (This date is the Owner's deadline for internal management of contract accounts. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.)

### **ARTICLE 3 INELIGIBLE BIDDER**

**3.1** By signing this contract the Contractor attests that it has not been declared ineligible to bid on State of Maine projects. The Bureau of General Services may disallow award of this contract to any Contractor if there is evidence that the Contractor or any of its Subcontractors, through their own fault, have been terminated, suspended for cause, debarred from bidding, agreed to refrain from bidding as part of a settlement, have defaulted on a contract, or had a contract completed by another party.

**3.2** By signing this contract the Contractor attests that it is not presently indicted for or otherwise criminally or civilly charged by a Federal, State or local government entity with commission of any of the following offenses and has not within a three-year period preceding this bid been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction, or contract under a public transaction, violation of Federal or State anti-trust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property.

**3.3** The Contractor shall not make any award or permit any award (subgrant or contract) at any tier to any party which is debarred or suspended or is otherwise excluded from or ineligible for participation in Federal assistance programs or State of Maine projects.

### **ARTICLE 4 CONTRACTOR'S RESPONSIBILITIES**

**4.1** On this project, the Contractor shall furnish the Owner the appropriate contract bonds in the amount of 100% of the Contract Sum. Contract bonds are mandated if the Contract Sum exceeds \$125,000, or if bonds are specifically required by the Contract Documents.

**4.2** The Contractor shall comply with all laws, codes and regulations applicable to the Work.

**4.3** The Contractor shall acquire all permits and third-party approvals applicable to the Work not specifically identified as provided by the Owner. Costs for Contractor-provided permits and third-party approvals shall be included in the Contract Sum identified in Section 1.1 above.

**4.4** The Contractor shall remain an independent agent for the duration of this Contract, shall not become an employee of the State of Maine, and shall assure that no State employee will be compensated by, or otherwise benefit from, this Contract.

**4.5** The Contractor shall be responsible for any design cost, construction cost, or other cost incurred on the Project to the extent caused by the negligent acts, errors or omissions of the Contractor or their Subcontractors in the performance of Work under this Contract.

**ARTICLE 5 OWNER'S RESPONSIBILITIES**

**5.1** The Owner shall provide full information about the objectives, schedule, constraints and existing conditions of the project. The Owner has established a budget with reasonable contingencies that meets the project requirements.

**5.2** By signing this contract, the Owner attests that all State of Maine procurement requirements for this contract have been met, including the solicitation of competitive bids.

**ARTICLE 6 INSTRUMENTS OF SERVICE**

**6.1** The Contractor's use of the drawings, specifications and other documents known as the Consultant's Instruments of Service is limited to the execution of the Contractor's scope of work of this project unless the Contractor receives the written consent of the Owner and Consultant for use elsewhere.

**ARTICLE 7 MISCELLANEOUS PROVISIONS**

**7.1** This Contract shall be governed by the laws of the State of Maine.

**7.2** The Owner and Contractor, respectively, bind themselves, their partners, successors, assigns and legal representatives to this Contract. Neither party to this Contract shall assign the Contract as a whole without written consent of the other party, which consent the Owner may withhold without cause.

**7.3** Notwithstanding any other provision of this Agreement, if the Owner does not receive sufficient funds to fund this Agreement or funds are de-appropriated, or if the Owner does not receive legal authority from the Maine State Legislature or Maine Courts to expend funds intended for this Agreement, then the Owner is not obligated to make payment under this Agreement; provided, however, the Owner shall be obligated to pay for services satisfactorily performed prior to any such non-appropriation in accordance with the termination provisions of this Agreement. The Owner shall timely notify the Contractor of any non-appropriation and the effective date of the non-appropriation.

**ARTICLE 8 CONTRACT DOCUMENTS**

**8.1** The Project Manual, Specifications and Drawings, and any Addenda, together with this agreement, form the contract. Each element is as fully a part of the Contract as if hereto attached or herein repeated.

**8.2** Specifications: *indicate date of issuance of project manual*

**8.3** Drawings: *note here or attach each sheet number and title*

**8.4** Addenda: *note each addenda number and date, or "none"*

BGS Project No.: \_\_\_\_\_

The Contract is effective as of the date executed by the approval authority.

**OWNER****CONTRACTOR**

---

*Signature*                      *Date*  
*name and title**name of contracting entity*  
*address**telephone*  
*email address*

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*Signature*                      *Date*  
*name and title**name of contractor company*  
*address**telephone*  
*email address*  
*Vendor Number**Indicate the names of the review and approval individuals appropriate to the approval authority.***select proper approval authority****Reviewed by:****Approved by:**

---

*Signature*                      *Date*  
*insert name**Project Manager/ Contract Administrator*

---

*Signature*                      *Date*  
*John Kenney, P.E.**Director, Planning Design and Construction*  
*Division (PDCD)*

**00 61 13.13**  
**Contractor Performance Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.13**  
**Contractor Performance Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

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

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

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

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.

**00 61 13.16**  
**Contractor Payment Bond**

Bond No.: insert bond number

We, the undersigned, insert company name of Contractor, select type of entity of insert name of municipality in the State of insert name of state as principal, and insert name of surety as Surety, are hereby held and firmly bound unto select title of obligee in the penal sum of the Contract Price \$ insert the Contract Price in numbers for the use and benefit of claimants, defined as an entity having a contract with the principal or with a subcontractor of the principal for labor, materials, or both labor and materials, used or reasonably required for use in the performance of the contract, for the payment of which, well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

The condition of the above obligation is such that if the principal shall promptly satisfy all claims and demands incurred for all labor and materials, used or required by the principal in connection with the work described in the contract entered into this insert date, i.e.: 8th day of select month, select year, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract, for the construction of insert name of project as designated in the contract documents, and shall fully reimburse the obligee for all outlay and expense with said obligee may incur in making good any default of said principal, then this obligation shall be null and void.

Otherwise, the same shall remain in force and effect- it being expressly understood and agreed that the liability of the Surety for any and all claims hereunder shall, in no event, exceed the penal amount of this obligation as herein stated.

The Surety, for value received hereby stipulates and agrees that the obligation of said Surety and its bonds shall be in no way impaired or affected by any extension of the time which the Obligee may accept during the performance of the contract and said Surety does hereby waive notice of any such extension.

**00 61 13.16**  
**Contractor Payment Bond**

In witness whereof, the principal and the Surety have hereunto set their hands and seals, and such of them as are corporations have caused their corporate seals to be hereto affixed and these presents to be signed by their proper officers, the day and year first set above.

Signed and sealed this *insert date, i.e.: 8th* day of *select month, select year*, which is the same date as that of the notice of intent to award letter, or in the absence of such a letter, not later than the date the Owner signs the construction contract.

**Contractor**

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

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

**Surety**

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

*insert name and title*

*insert company name*

*insert address*

*insert city state zip code*

If Contractor is a partnership, all partners shall execute the bond. A power of attorney document indicating that it still is in full force and effect shall be provided by the person executing this bond.



**00 71 00**  
**Definitions**

1. Definitions

- 1.1 *Addendum*: A document issued by the Consultant that amends the Bid Documents. Addenda shall not be issued less than seventy-two hours prior to the specified bid opening time.
- 1.2 *Allowance*: A specified dollar amount for a particular scope of work or service included in the Work that is identified in the Bid Documents and included in each Bidder's Bid. The Contractor shall document expenditures for an Allowance during the Project. Any unused balance shall be credited to the Owner. The Contractor is responsible for notifying the Owner of anticipated expenses greater than the specified amount and the Owner is responsible for those additional expenses.
- 1.3 *Alternate Bid*: The Contractor's written offer of a specified dollar amount, submitted on the Bid Form, for the performance of a particular scope of work described in the Bid Documents. The Owner determines the low bidder based on the sum of the base Bid and any combination of Alternate Bids that the Owner selects.
- 1.4 *Architect*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.5 *Architectural Supplemental Instruction (ASI)*: A written instruction from the Architect for the purpose of clarification of the Contract Documents. An ASI does not alter the Contract Price or Contract Time. ASIs may be responses to RFIs and shall be issued by the Architect in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.6 *Bid*: The Contractor's written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of the Work. A Bid may include bonds or other requirements. A base Bid is separate and distinct from Alternate Bids, being the only cost component necessary for the award of the contract, and representing the minimum amount of Work that is essential for the functioning of the Project.
- 1.7 *Bid Bond*: The security designated in the Bid Documents, furnished by Bidders as a guaranty of good faith to enter into a contract with the Owner, should a contract be awarded to that Bidder.
- 1.8 *Bidder*: Any business entity, individual or corporation that submits a bid for the performance of the work described in the Bid Documents, acting directly or through a duly authorized representative. See also *Responsive and Responsible Bidder*.
- 1.9 *Bid Documents*: The drawings, procurement and contracting requirements, general requirements, and the written specifications -including all addenda, that a bidder is required to reference in the submission of a bid.
- 1.10 *Bureau*: The State of Maine Bureau of General Services, or BGS, in the Department of Administrative and Financial Services.
- 1.11 *Calendar days*: Consecutive days, as occurring on a calendar, taking into account each day of the week, month, year, and any religious, national or local holidays. Calendar days are used for changes in Contract Time.

**00 71 00**  
**Definitions**

- 1.12 *Certificate of Substantial Completion*: A document developed by the Consultant that describes the final status of the Work and establishes the date that the Owner may use the facility for its intended purpose. The Certificate of Substantial Completion may also include a provisional list of items - a "punch list" - remaining to be completed by the Contractor. The Certificate of Substantial Completion identifies the date from which the project warranty period commences.
- 1.13 *Certificate of Occupancy*: A document developed by a local jurisdiction such as the Code Enforcement Officer that grants permission to the Owner to occupy a building.
- 1.14 *Change Order (CO)*: A document that modifies the contract and establishes the basis of a specific adjustment to the Contract Price or the Contract Time, or both. Change Orders may address correction of omissions, errors, and document discrepancies, or additional requirements. Change Orders should include all labor, materials and incidentals required to complete the work described. A Change Order is not valid until signed by the Contractor, Owner and Consultant and approved by the Bureau.
- 1.15 *Change Order Proposal (COP) (see also Proposal)*: Contract change proposed by the Contractor regarding the contract amount, requirements, or time. The Contractor implements the work of a COP after it is accepted by all parties. Accepted COPs are incorporated into the contract by Change Order.
- 1.16 *Clerk of the Works*: The authorized representative of the Consultant on the job site. Clerk of the Works is sometimes called the Architect's representative.
- 1.17 *Construction Change Directive (CCD)*: A written order prepared by the Consultant and signed by the Owner and Consultant, directing a change in the Work prior to final agreement with the Contractor on adjustment, if any, in the Contract Price or Contract Time, or both.
- 1.18 *Contract*: A written agreement between the Owner and the successful bidder which obligates the Contractor to perform the work specified in the Contract Documents and obligates the Owner to compensate the Contractor at the mutually accepted sum, rates or prices.
- 1.19 *Contract Bonds (also known as Payment and Performance Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.20 *Contract Documents*: The drawings and written specifications (including all addenda), Standard General Conditions, and the contract (including all Change Orders subsequently incorporated in the documents).
- 1.21 *Contract Expiration Date*: Date determined by the Owner as a deadline for internal management of contract accounts. This allows time after the Contract Final Completion Date for processing the final Requisition for Payment. The Contract Expiration Date does not directly relate to any contract obligation of the Contractor.
- 1.22 *Contract Final Completion Date*: Point of time when the Work is fully completed in compliance with the Contract Documents, as certified by the Consultant. Final payment to the Contractor is due upon Final Completion of the Project.
- 1.23 *Contract Price*: The dollar amount of the construction contract, also called *Contract Sum*.

**00 71 00**  
**Definitions**

- 1.24 *Contract Time*: The designated duration of time to execute the Work of the contract, with a specific date for completion.
- 1.25 *Contractor*: Also called the "General Contractor" or "GC" the individual or entity undertaking the execution of the general contract work under the terms of the contract with the Owner, acting directly or through a duly authorized representative. The Contractor is responsible for the means, methods and materials utilized in the execution and completion of the Work.
- 1.26 *Consultant*: The Architect or Engineer acting as Professional-of-Record for the Project. The Consultant is responsible for the design of the Project.
- 1.27 *Drawings*: The graphic and pictorial portion of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.
- 1.28 *Engineer*: A Consultant acting as, or supporting, the Professional-of-Record who is responsible for the design of the Project. Equivalent to "Consultant" in State of Maine contract forms.
- 1.29 *Filed Sub-bid*: The designated major Subcontractor's (or, in some cases, Contractor's) written offer of a specified dollar amount or amounts, submitted on a form included in the Bid Documents, for the performance of a particular portion of the Work. A Filed Sub-bid may include bonds or other requirements.
- 1.30 *General Requirements*: The on-site overhead expense items the Contractor provides for the Project, typically including, but not limited to, building permits, construction supervision, Contract Bonds, insurance, field office, temporary utilities, rubbish removal, and site fencing. Overhead expenses of the Contractor's general operation are not included. Sometimes referred to as the Contractor's General Conditions.
- 1.31 *Owner*: The State agency which is represented by duly authorized individuals. The Owner is responsible for defining the scope of the Project and compensation to the Consultant and Contractor.
- 1.32 *Owner's Representative*: The individual or entity contracted by the Owner to be an advisor and information conduit regarding the Project.
- 1.33 *Overhead*: General and administrative expenses of the Contractor's principal and branch offices, including payroll costs and other compensation of Contractor employees, deductibles paid on any insurance policy, charges against the Contractor for delinquent payments, and costs related to the correction of defective work, and the Contractor's capital expenses, including interest on capital used for the work.
- 1.34 *Performance and Payment Bonds (also known as Contract Bonds)*: The approved forms of security, furnished by the Contractor and their surety, which guarantee the faithful performance of all the terms of the contract and the payment of all bills for labor, materials and equipment by the Contractor.
- 1.35 *Post-Bid Addendum*: Document issued by the Consultant that defines a potential Change Order prior to signing of the construction contract. The Post-Bid Addendum allows the Owner to negotiate

**00 71 00**  
**Definitions**

contract changes with the Bidder submitting the lowest valid bid, only if the negotiated changes to the Bid Documents result in no change or no increase in the bid price.

A Post-Bid Addendum may also be issued after a competitive construction Bid opening to those Bidders who submitted a Bid initially, for the purpose of rebidding the Project work without re-advertising.

- 1.36 *Project*: The construction project proposed by the Owner to be constructed according to the Contract Documents. The Project, a public improvement, may be tied logistically to other public improvements and other activities conducted by the Owner or other contractors.
- 1.37 *Proposal (see also Change Order Proposal)*: The Contractor's written offer submitted to the Owner for consideration containing a specified dollar amount or rate, for a specific scope of work, and including a schedule impact, if any. A proposal shall include all costs for overhead and profit. The Contractor implements the work of a Proposal after it is accepted by all parties. Accepted Proposals are incorporated into the contract by Change Order.
- 1.38 *Proposal Request (PR)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.39 *Punch List*: A document that identifies the items of work remaining to be done by the Contractor at the Close Out of a Project. The Punch List is created as a result of a final inspection of the work only after the Contractor attests that all of the Work is in its complete and permanent status.
- 1.40 *Request For Information (RFI)*: A Contractor's written request to the Consultant for clarification, definition or description of the Work. RFIs shall be presented by the Contractor in a timely manner to avoid any negative impact on the Schedule of the Work.
- 1.41 *Request For Proposal (RFP)*: An Owner's written request to the Contractor for a Change Order Proposal.
- 1.42 *Requisition for Payment*: The document in which the Contractor certifies that the Work described is, to the best of the Contractor's knowledge, information and belief, complete and that all previous payments have been paid by the Contractor to Subcontractors and suppliers, and that the current requested payment is now due. See *Schedule of Values*.
- 1.43 *Responsive and Responsible Bidder*: A bidder who complies, when submitting a bid on a given project, with the following *responsive* standards, as required by the Bid Documents:
  - submits specific qualifications to bid the project, if required;
  - attends mandatory pre-bid conferences, if required;
  - submits a bid prior to the close of the bid period;
  - submits a complete bid form;
  - submits a bid without indications of intent contrary to the stated requirements;
  - submits other materials and information, such as bid security, as required;
 and, meets the following minimums regarding these *responsible* standards:
  - sustains a satisfactory record of project performance;
  - maintains a permanent place of business in a known physical location;
  - possesses the financial means for short- and long-term operations;
  - possesses the appropriate technical experience and capabilities;
  - employs adequate personnel and subcontractor resources;

**00 71 00**  
**Definitions**

maintains the equipment needed to perform the work;  
complies with the proposed implementation schedule;  
complies with the insurance and bonding requirements;  
provides post-construction warranty coverage;  
and other criteria which can be considered relevant to the contract.

- 1.44 *Retainage*: The amount, calculated at five percent (5%) of the contract value or a scheduled value, that the Owner shall withhold from the Contractor until the work or portion of work is declared substantially complete or otherwise accepted by the Owner. The Owner may, if requested, reduce the amount withheld if the Owner deems it desirable and prudent to do so. (See Title 5 M.R.S.A., Section 1746.)
- 1.45 *Sample*: A physical example provided by the Contractor which illustrates materials, equipment or workmanship and establishes standards by which the Work will be judged.
- 1.46 *Schedule of the Work*: The document prepared by the Contractor and approved by the Owner that specifies the dates on which the Contractor plans to begin and complete various parts of the Work, including dates on which information and approvals are required from the Owner.
- 1.47 *Schedule of Values*: The document prepared by the Contractor and approved by the Owner before the commencement of the Work that specifies the dollar values of discrete portions of the Work equal in sum to the contract amount. The Schedule of Values is used to document progress payments of the Work in regular (usually monthly) requisitions for payment. See *Requisition for Payment*.
- 1.48 *Shop Drawings*: The drawings, diagrams, schedules and other data specially prepared for the Work by the Contractor or a Subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.
- 1.49 *Specifications*: The portion of the Contract Documents consisting of the written requirements of the Work for materials, equipment, systems, standards, workmanship, and performance of related services.
- 1.50 *Subcontractor*: An individual or entity undertaking the execution of any part of the Work by virtue of a written agreement with the Contractor or any other Subcontractor. Also, an individual or entity retained by the Contractor or any other Subcontractor as an independent contractor to provide the labor, materials, equipment or services necessary to complete a specific portion of the Work.
- 1.51 *Substantial Completion Date*: Point of time when the Work or a designated portion of the Work is sufficiently complete in compliance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended purpose without unscheduled disruption. Substantial Completion is documented by the date of the Certificate of Substantial Completion signed by the Owner and the Contractor.
- 1.52 *Superintendent*: The representative of the Contractor on the job site, authorized by the Contractor to receive and fulfill instructions from the Consultant.
- 1.53 *Surety*: The individual or entity that is legally bound with the Contractor and Subcontractor to insure the faithful performance of the contract and for the payment of the bills for labor, materials and equipment by the Contractor and Subcontractors.

**00 71 00**  
**Definitions**

- 1.54 *Work*: The construction and services, whether completed or partially completed, including all labor, materials, equipment and services provided or to be provided by the Contractor and Subcontractors to fulfill the requirements of the Project as described in the Contract Documents.

**00 72 13**  
**General Conditions**

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**1. Preconstruction Conference**

- 1.1 The Contractor shall, upon acceptance of a contract and prior to commencing work, schedule a preconstruction conference with the Owner and Consultant. The purpose of this conference is as follows.
  - 1.1.1 Introduce all parties who have a significant role in the Project, including:
    - Owner (State agency or other contracting entity)
      - Owner's Representative
    - Consultant (Architect or Engineer)
      - Subconsultants
      - Clerk-of-the-works
    - Contractor (GC)
      - Superintendent
      - Subcontractors
    - Other State agencies
    - Construction testing company
    - Commissioning agent
    - Special Inspections agent
    - Bureau of General Services (BGS);
  - 1.1.2 Review the responsibilities of each party;
  - 1.1.3 Review any previously-identified special provisions of the Project;
  - 1.1.4 Review the Schedule of the Work calendar submitted by the Contractor to be approved by the Owner and Consultant;
  - 1.1.5 Review the Schedule of Values form submitted by the Contractor to be approved by the Owner and Consultant;
  - 1.1.6 Establish routines for Shop Drawing approval, contract changes, requisitions, et cetera;
  - 1.1.7 discuss jobsite issues;
  - 1.1.8 Discuss Project close-out procedures;
  - 1.1.9 Provide an opportunity for clarification of Contract Documents before work begins; and
  - 1.1.10 Schedule regular meetings at appropriate intervals for the review of the progress of the Work.

**2. Intent and Correlation of Contract Documents**

- 2.1 The intent of the Contract Documents is to describe the complete Project. The Contract Documents consist of various components; each component complements the others. What is shown as a requirement by any one component shall be inferred as a requirement on all corresponding components.
- 2.2 The Contractor shall furnish all labor, equipment and materials, tools, transportation, insurance, services, supplies, operations and methods necessary for, and reasonably incidental to, the construction and completion of the Project. Any work that deviates from the Contract Documents which appears to be required by the exigencies of construction or by inconsistencies in the Contract Documents, will be determined by the Consultant and authorized in writing by the Consultant, Owner and the Bureau prior to execution. The Contractor shall be responsible for requesting clarifying information where the intent of the Contract Documents is uncertain.
- 2.3 The Contractor shall not utilize any apparent error or omission in the Contract Documents to the disadvantage of the Owner. The Contractor shall promptly notify the Consultant in writing of such errors or omissions. The Consultant shall make any corrections or clarifications necessary in such a situation to document the true intent of the Contract Documents.



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**3. Additional Drawings and Specifications**

- 3.1 Upon the written request of the Contractor, the Owner shall provide, at no expense to the Contractor, up to five sets of printed Drawings and Specifications for the execution of the Work.
- 3.2 The Consultant shall promptly furnish to the Contractor revised Drawings and Specifications, for the area of the documents where those revisions apply, when corrections or clarifications are made by the Consultant. All such information shall be consistent with, and reasonably inferred from, the Contract Documents. The Contractor shall do no work without the proper Drawings and Specifications.

**4. Ownership of Contract Documents**

- 4.1 The designs represented on the Contract Documents are the property of the Consultant. The Drawings and Specifications shall not be used on other work without consent of the Consultant.

**5. Permits, Laws, and Regulations**

- 5.1 The Owner is responsible for obtaining any zoning approvals or other similar local project approvals necessary to complete the Work, unless otherwise specified in the Contract Documents.
- 5.2 The Owner is responsible for obtaining Maine Department of Environmental Protection, Maine Department of Transportation, or other similar state government project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.3 The Owner is responsible for obtaining any federal agency project approvals necessary to complete the Work, unless otherwise indicated in the Contract Documents.
- 5.4 The Owner is responsible for obtaining all easements for permanent structures or permanent changes in existing facilities.
- 5.5 The Contractor is responsible for obtaining and paying for all permits and licenses necessary for the implementation of the Work. The Contractor shall notify the Owner of any delays, variance or restrictions that may result from the issuing of permits and licenses.
- 5.6 The Contractor shall comply with all ordinances, laws, rules and regulations and make all required notices bearing on the implementation of the Work. In the event the Contractor observes disagreement between the Drawings and Specifications and any ordinances, laws, rules and regulations, the Contractor shall promptly notify the Consultant in writing. Any necessary changes shall be made as provided in the contract for changes in the work. The Contractor shall not perform any work knowing it to be contrary to such ordinances, laws, rules and regulations.
- 5.7 The Contractor shall comply with local, state and federal regulations regarding construction safety and all other aspects of the Work.
- 5.8 The Contractor shall comply with the Maine Code of Fair Practices and Affirmative Action, 5 M.R.S. §784 (2).

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**6. Taxes**

- 6.1 The Owner is exempt from the payment of Maine State sales and use taxes as provided in 36 M.R.S. §1760 (1). The Contractor and Subcontractors shall not include taxes on exempt items in the construction contract.
- 6.2 Section 1760 further provides in subsection 61 that sales to a construction contractor or its subcontractor of tangible personal property that is to be physically incorporated in, and become a permanent part of, real property for sale to or owned by the Owner, are exempt from Maine State sales and use taxes. Tangible personal property is defined in 36 M.R.S. §1752 (17).
- 6.3 The Contractor may contact Maine Revenue Services, 24 State House Station, Augusta, Maine 04333 for guidance on tax exempt regulations authorized by 36 M.R.S. §1760 and detailed in Rule 302 (18-125 CMR 302).

**7. Labor and Wages**

- 7.1 The Contractor shall conform to the labor laws of the State of Maine, and all other laws, ordinances, and legal requirements affecting the work in Maine.
- 7.2 The Consultant shall include a wage determination document prepared by the Maine Department of Labor in the Contract Documents for state-funded contracts in excess of \$50,000. The document shows the minimum wages required to be paid to each category of labor employed on the project.
- 7.3 On projects requiring a Maine wage determination, the Contractor shall submit monthly payroll records to the Owner ("the contracting agency") showing the name and occupation of all workers and all independent contractors employed on the project. The monthly submission must also include the Contractor's company name, the title of the project, hours worked, hourly rate or other method of remuneration, and the actual wages or other compensation paid to each person.
- 7.4 The Contractor shall not reveal, in the payroll records submitted to the Owner, personal information regarding workers and independent contractors, other than the information described above. Such information shall not include Social Security number, employee identification number, or employee address or phone number, for example.
- 7.5 The Contractor shall conform to Maine statute (39-A M.R.S. §105-A (6)) by providing to the Workers' Compensation Board a list of all subcontractors and independent contractors on the job site and a record of the entity to whom that subcontractor or independent contractor is directly contracted and by whom that subcontractor or independent contractor is insured for workers' compensation purposes.
- 7.6 The Contractor shall enforce strict discipline and good order among their employees at all times, and shall not employ any person unfit or unskilled to do the work assigned to them.
- 7.7 The Contractor shall promptly pay all employees when their compensation is due, shall promptly pay all others who have billed and are due for materials, supplies and services used in the Work, and shall promptly pay all others who have billed and are due for insurance, workers compensation coverage, federal and state unemployment compensation, and Social Security

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charges pertaining to this Project. Before final payments are made, the Contractor shall furnish to the Owner affidavits that all such payments described above have been made.

- 7.8 The Contractor may contact the Maine Department of Labor, 54 State House Station, Augusta, Maine 04333 for guidance on labor issues.
- 7.9 The Contractor may contact the Maine Workers' Compensation Board, 27 State House Station, Augusta, Maine 04333 for guidance on workers' compensation issues.

**8. Indemnification**

- 8.1 The Contractor shall indemnify and hold harmless the Owner and its officers and employees from and against any and all damages, liabilities, and costs, including reasonable attorney's fees, and defense costs, for any and all injuries to persons or property, including claims for violation of intellectual property rights, to the extent caused by the negligent acts or omissions of the Contractor, its employees, agents, officers or subcontractors in the performance of work under this Agreement. The Contractor shall not be liable for claims to the extent caused by the negligent acts or omissions of the Owner or for actions taken in reasonable reliance on written instructions of the Owner.
- 8.2 The Contractor shall notify the Owner promptly of all claims arising out of the performance of work under this Agreement by the Contractor, its employees or agents, officers or subcontractors.
- 8.3 This indemnity provision shall survive the termination of the Agreement, completion of the project or the expiration of the term of the Agreement.

**9. Insurance Requirements**

- 9.1 The Contractor shall provide, with each original of the signed Contract, an insurance certificate or certificates acceptable to the Owner and BGS. The Contractor shall submit insurance certificates to the Owner and BGS at the commencement of this Contract and at policy renewal or revision dates. The certificates shall identify the project name and BGS project number, and shall name the Owner as certificate holder and as additional insured for general liability and automobile liability coverages. The submitted forms shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least ten days prior written notice by registered letter has been given to the Owner and BGS.
- 9.2 The Owner does not warrant or represent that the insurance required herein constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Subcontractors. The Contractor is responsible for the existence, extent and adequacy of insurance prior to commencement of work. The Contractor shall not allow any Subcontractor to commence work until all similar insurance required of the Subcontractor has been confirmed by the Contractor.
- 9.3 The Contractor shall procure and maintain primary insurance for the duration of the Project and, if written on a Claims-Made basis, shall also procure and maintain Extended Reporting Period (ERP) insurance for the period of time that any claims could be brought. The Contractor shall ensure that all Subcontractors they engage or employ will procure and maintain similar insurance

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in form and amount acceptable to the Owner and BGS. At a minimum, the insurance shall be of the types and limits set forth herein protecting the Contractor from claims which may result from the Contractor's execution of the Work, whether such execution be by the Contractor or by those employed by the Contractor or by those for whose acts they may be liable. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine by the Maine Bureau of Insurance.

- 9.3.1 The Contractor shall have Workers' Compensation insurance for all employees on the Project site in accordance with the requirements of the Workers' Compensation law of the State of Maine.

Minimum acceptable limits for Employer's Liability are:

Bodily Injury by Accident.....	\$500,000
Bodily Injury by Disease.....	\$500,000 Each Employee
Bodily Injury by Disease.....	\$500,000 Policy Limit

- 9.3.2 The Contractor shall have Commercial General Liability insurance providing coverage for bodily injury and property damage liability for all hazards of the Project including premise and operations, products and completed operations, contractual, and personal injury liabilities. The policy shall include collapse and underground coverage as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a location or project basis. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Products and completed operations aggregate .....	\$1,000,000
Each occurrence limit.....	\$1,000,000
Personal injury aggregate .....	\$1,000,000

- 9.3.3 The Contractor shall have Automobile Liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, ownership or use of all owned, non-owned and hired automobiles, trucks and trailers. Minimum acceptable limit is:

Any one accident or loss .....	\$500,000
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- 9.3.4 For the portion of a project which is new construction, the Contractor shall procure and maintain Builder's Risk insurance naming the Owner, Contractor, and any Subcontractor as insureds as their interest may appear. Covered causes of loss form shall be all Risks of Direct Physical Loss, endorsed to include flood, earthquake, transit and sprinkler leakage where sprinkler coverage is applicable. Unless specifically authorized in writing by the Owner, the limit of insurance shall not be less than the initial contract amount, for the portion of the project which is new construction, and coverage shall apply during the entire contract period and until the work is accepted by the Owner.

- 9.3.5 The Contractor shall have Owner's Protective Liability insurance for contract values \$50,000 and above, naming the Owner as the Named Insured. Minimum acceptable limits are:

General aggregate limit.....	\$2,000,000
Each occurrence limit.....	\$1,000,000

## 10. Contract Bonds

- 10.1 When noted as required in the Bid Documents, the Contractor shall provide to the Owner a Performance Bond and a Payment Bond, or "contract bonds", upon execution of the contract. Each bond value shall be for the full amount of the contract and issued by a surety company authorized to do business in the State of Maine as approved by the Owner. The bonds shall be

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executed on the forms furnished in the Bid Documents. The bonds shall allow for any subsequent additions or deductions of the contract.

- 10.2 The contract bonds shall continue in effect for one year after final acceptance of the contract to protect the Owner's interest in connection with the one year guarantee of workmanship and materials and to assure settlement of claims for the payment of all bills for labor, materials and equipment by the Contractor.

**11. Patents and Royalties**

- 11.1 The Contractor shall, for all time, secure for the Owner the free and undisputed right to the use of any patented articles or methods used in the Work. The expense of defending any suits for infringement or alleged infringement of such patents shall be borne by the Contractor. Awards made regarding patent suits shall be paid by the Contractor. The Contractor shall hold the Owner harmless regarding patent suits that may arise due to installations made by the Contractor, and to any awards made as a result of such suits.
- 11.2 Any royalty payments related to the work done by the Contractor for the Project shall be borne by the Contractor. The Contractor shall hold the Owner harmless regarding any royalty payments that may arise due to installations made by the Contractor.

**12. Surveys, Layout of Work**

- 12.1 The Owner shall furnish all property surveys unless otherwise specified.
- 12.2 The Contractor is responsible for correctly staking out the Work on the site. The Contractor shall employ a competent surveyor to position all construction on the site. The surveyor shall run the axis lines, establish correct datum points and check each line and point on the site to insure their accuracy. All such lines and points shall be carefully preserved throughout the construction.
- 12.3 The Contractor shall lay out all work from dimensions given on the Drawings. The Contractor shall take measurements and verify dimensions of any existing work that affects the Work or to which the Work is to be fitted. The Contractor is solely responsible for the accuracy of all measurements. The Contractor shall verify all grades, lines, levels, elevations and dimensions shown on the Drawings and report any errors or inconsistencies to the Consultant prior to commencing work.

**13. Record of Documents**

- 13.1 The Contractor shall maintain one complete set of Contract Documents on the jobsite, in good order and current status, for access by the Owner and Consultant.
- 13.2 The Contractor shall maintain, continuously updated, complete records of Requests for Information, Architectural Supplemental Instructions (or equivalent), Information Bulletins, supplemental sketches, Change Order Proposals, Change Orders, Shop Drawings, testing reports, et cetera, for access by the Owner and Consultant.

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**14. Allowances**

- 14.1 The Contract Price shall include all allowances described in the Contract Documents. The Contractor shall include all overhead and profit necessary to implement each allowance in their Contract Price.
- 14.2 The Contractor shall not be required to employ parties for allowance work against whom the Contractor has a reasonable objection. In such a case, the Contractor shall notify the Owner in writing of their position and shall propose an alternative party to complete the work of the allowance.

**15. Shop Drawings**

- 15.1 The Contractor shall administer Shop Drawings prepared by the Contractor, Subcontractors, suppliers or others to conform to the approved Schedule of the Work. The Contractor shall verify all field measurements, check and authorize all Shop Drawings and schedules required by the Work. The Contractor is the responsible party and contact for the Contractor's work as well as that of Subcontractors, suppliers or others who provide Shop Drawings.
- 15.2 The Consultant shall review and acknowledge Shop Drawings, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents.
- 15.3 The Contractor shall provide monthly updated logs containing: requests for information, information bulletins, supplemental instructions, supplemental sketches, change order proposals, change orders, submittals, testing and deficiencies.
- 15.4 The Contractor shall make any corrections required by the Consultant, and shall submit a quantity of corrected copies as may be needed. The acceptance of Shop Drawings or schedules by the Consultant shall not relieve the Contractor from responsibility for deviations from Drawings and Specifications, unless the Contractor has called such deviations to the attention of the Consultant at the time of submission and secured the Consultant's written approval. The acceptance of Shop Drawings or schedules by the Consultant does not relieve the Contractor from responsibility for errors in Shop Drawings or schedules.

**16. Samples**

- 16.1 The Contractor shall furnish for approval, with reasonable promptness, all samples as directed by the Consultant. The Consultant shall review and approve such samples, with reasonable promptness, for general conformity with the design concept of the project and compliance with the information provided in the Contract Documents. The subsequent work shall be in accord with the approved samples.

**17. Substitutions**

- 17.1 The Contractor shall furnish items and materials described in the Contract Documents. If the item or material specified describes a proprietary product, or uses the name of a manufacturer, the term "or approved equal" shall be implied, if it is not included in the text. The specific item or material specified establishes a minimum standard for the general design, level of quality, type, function, durability, efficiency, reliability, compatibility, warranty coverage, installation factors

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and required maintenance. The Drawing or written Specification shall not be construed to exclude other manufacturers products of comparable design, quality, and efficiency.

- 17.2 The Contractor may submit detailed information about a proposed substitution to the Consultant for consideration. Particular models of items and particular materials which the Contractor asserts to be equal to the items and materials identified in the Contract Documents shall be allowed only with written approval by the Consultant. The request for substitution shall include a cost comparison and a reason or reasons for the substitution.
- 17.3 The Consultant may request additional information about the proposed substitution. The approval or rejection of a proposed substitution may be based on timeliness of the request, source of the information, the considerations of minimum standards described above, or other considerations. The Consultant should briefly state the rationale for the decision. The decision shall be considered final.
- 17.4 The duration of a substitution review process can not be the basis for a claim for delay in the Schedule of the Work.

**18. Assignment of Contract**

- 18.1 The Contractor shall not assign or sublet the contract as a whole without the written consent of the Owner. The Contractor shall not assign any money due to the Contractor without the written consent of the Owner.

**19. Separate Contracts**

- 19.1 The Owner reserves the right to create other contracts in connection with this Project using similar General Conditions. The Contractor shall allow the Owner's other contractors reasonable opportunity for the delivery and storage of materials and the execution of their work. The Contractor shall coordinate and properly connect the Work of all contractors.
- 19.2 The Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in work of the Owner's other contractors that impacts the proper execution or results of the Contractor. The Contractor's failure to observe or report any deficiencies constitutes an acceptance of the Owner's other contractors work as suitable for the interface of the Contractor's work, except for latent deficiencies in the Owner's other contractors work.
- 19.3 Similarly, the Contractor shall promptly report to the Consultant and Owner any apparent deficiencies in their own work that would impact the proper execution or results of the Owner's other contractors.
- 19.4 The Contractor shall report to the Consultant and Owner any conflicts or claims for damages with the Owner's other contractors and settle such conflicts or claims for damages by mutual agreement or arbitration, if necessary, at no expense to the Owner.
- 19.5 In the event the Owner's other contractors sue the Owner regarding any damage alleged to have been caused by the Contractor, the Owner shall notify the Contractor, who shall defend such proceedings at the Contractor's expense. The Contractor shall pay or satisfy any judgment that may arise against the Owner, and pay all other costs incurred.

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**20. Subcontracts**

- 20.1 The Contractor shall not subcontract any part of this contract without the written permission of the Owner.
- 20.2 The Contractor shall submit a complete list of named Subcontractors and material suppliers to the Consultant and Owner for approval by the Owner prior to commencing work. The Subcontractors named shall be reputable companies of recognized standing with a record of satisfactory work.
- 20.3 The Contractor shall not employ any Subcontractor or use any material until they have been approved, or where there is reason to believe the resulting work will not comply with the Contract Documents.
- 20.4 The Contractor, not the Owner, is as fully responsible for the acts and omissions of Subcontractors and of persons employed by them, as the Contractor is for the acts and omissions of persons directly or indirectly employed by the Contractor.
- 20.5 Neither the Contract Documents nor any Contractor-Subcontractor contract shall indicate, infer or create any direct contractual relationship between any Subcontractor and the Owner.

**21. Contractor-Subcontractor Relationship**

- 21.1 The Contractor shall be bound to the Subcontractor by all the obligations in the Contract Documents that bind the Contractor to the Owner.
- 21.2 The Contractor shall pay the Subcontractor, in proportion to the dollar value of the work completed and requisitioned by the Subcontractor, the approved dollar amount allowed to the Contractor no more than seven days after receipt of payment from the Owner.
- 21.3 The Contractor shall pay the Subcontractor accordingly if the Contract Documents or the subcontract provide for earlier or larger payments than described in the provision above.
- 21.4 The Contractor shall pay the Subcontractor for completed and requisitioned subcontract work, less retainage, no more than seven days after receipt of payment from the Owner for the Contractor's approved Requisition for Payment, even if the Consultant fails to certify a portion of the Requisition for Payment for a cause not the fault of the Subcontractor.
- 21.5 The Contractor shall not make a claim for liquidated damages or penalty for delay in any amount in excess of amounts that are specified by the subcontract.
- 21.6 The Contractor shall not make a claim for services rendered or materials furnished by the Subcontractor unless written notice is given by the Contractor to the Subcontractor within ten calendar days of the day in which the claim originated.
- 21.7 The Contractor shall give the Subcontractor an opportunity to present and to submit evidence in any progress conference or disputes involving subcontract work.



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- 21.8 The Contractor shall pay the Subcontractor a just share of any fire insurance payment received by the Contractor.
- 21.9 The Subcontractor shall be bound to the Contractor by the terms of the Contract Documents and assumes toward the Contractor all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner.
- 21.10 The Subcontractor shall submit applications for payment to the Contractor in such reasonable time as to enable the Contractor to apply for payment as specified.
- 21.11 The Subcontractor shall make any claims for extra cost, extensions of time or damages, to the Contractor in the manner provided in these General Conditions for like claims by the Contractor to the Owner, except that the time for the Subcontractor to make claims for extra cost is seven calendar days after the receipt of Consultant's instructions.

**22. Supervision of the Work**

- 22.1 During all stages of the Work the Contractor shall have a competent superintendent, with any necessary assistant superintendents, overseeing the project. The superintendent shall not be reassigned without the consent of the Owner unless a superintendent ceases to be employed by the Contractor due to unsatisfactory performance.
- 22.2 The superintendent represents the Contractor on the jobsite. Directives given by the Consultant or Owner to the superintendent shall be as binding as if given directly to the Contractor's main office. All important directives shall be confirmed in writing to the Contractor. The Consultant and Owner are not responsible for the acts or omissions of the superintendent or assistant superintendents.
- 22.3 The Contractor shall provide supervision of the Work equal to the industry's highest standard of care. The superintendent shall carefully study and compare all Contract Documents and promptly report any error, inconsistency or omission discovered to the Consultant. The Contractor may not necessarily be held liable for damages resulting directly from any error, inconsistency or omission in the Contract Documents or other instructions by the Consultant that was not revealed by the superintendent in a timely way.

**23. Observation of the Work**

- 23.1 The Contractor shall allow the Owner, the Consultant and the Bureau continuous access to the site for the purpose of observation of the progress of the work. All necessary safeguards and accommodations for such observations shall be provided by the Contractor.
- 23.2 The Contractor shall coordinate all required testing, approval or demonstration of the Work. The Contractor shall give sufficient notice to the appropriate parties of readiness for testing, inspection or examination.
- 23.3 The Contractor shall schedule inspections and obtain all required certificates of inspection for inspections by a party other than the Consultant.

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- 23.4 The Consultant shall make all scheduled observations promptly, prior to the work being concealed or buried by the Contractor. If approval of the Work is required of the Consultant, the Contractor shall notify the Consultant of the construction schedule in this regard. Work concealed or buried prior to the Consultant's approval may need to be uncovered at the Contractor's expense.
- 23.5 The Consultant may order reexamination of questioned work, and, if so ordered, the work must be uncovered by the Contractor. If the work is found to conform to the Contract Documents, the Owner shall pay the expense of the reexamination and remedial work. If the work is found to not conform to the Contract Documents, the Contractor shall pay the expense, unless the defect in the work was caused by the Owner's Contractor, whose responsibility the reexamination expense becomes.
- 23.6 The Bureau shall periodically observe the Work during the course of construction and make recommendations to the Contractor or Consultant as necessary. Such recommendations shall be considered and implemented through the usual means for changes to the Work.
24. Consultant's Status
- 24.1 The Consultant represents the Owner during the construction period, and observes the work in progress on behalf of the Owner. The Consultant has authority to act on behalf of the Owner only to the extent expressly provided by the Contract Documents or otherwise demonstrated to the Contractor. The Consultant has authority to stop the work whenever such an action is necessary, in the Consultant's reasonable opinion, to ensure the proper execution of the contract.
- 24.2 The Consultant is the interpreter of the conditions of the contract and the judge of its performance. The Consultant shall favor neither the Owner nor the Contractor, but shall use the Consultant's powers under the contract to enforce faithful performance by both parties.
- 24.3 In the event of the termination of the Consultant's employment on the project prior to completion of the work, the Owner shall appoint a capable and reputable replacement. The status of the new Consultant relative to this contract shall be that of the former Consultant.
25. Management of the Premises
- 25.1 The Contractor shall place equipment and materials, and conduct activities on the premises in a manner that does not unreasonably hinder site circulation, environmental stability, or any long term effect. Likewise, the Consultant's directions shall not cause the use of premises to be impeded for the Contractor or Owner.
- 25.2 The Contractor shall not use the premises for any purpose other than that which is directly related to the scope of work. The Owner shall not use the premises for any purpose incompatible with the proposed work simultaneous to the work of the Contractor.
- 25.3 The Contractor shall enforce the Consultant's instructions regarding information posted on the premises such as signage and advertisements, as well as activities conducted on the premises such as fires, and smoking.

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25.4 The Owner may occupy any part of the Project that is completed with the written consent of the Contractor, and without prejudice to any of the rights of the Owner or Contractor. Such use or occupancy shall not, in and of itself, be construed as a final acceptance of any work or materials.

**26. Safety and Security of the Premises**

26.1 The Contractor shall designate, and make known to the Consultant and the Owner, a safety officer whose duty is the prevention of accidents on the site.

26.2 The Contractor shall continuously maintain security on the premises and protect from unreasonable occasion of injury all people authorized to be on the job site. The Contractor shall also effectively protect the property and adjacent properties from damage or loss.

26.3 The Contractor shall take all necessary precautions to ensure the safety of workers and others on and adjacent to the site, abiding by applicable local, state and federal safety regulations. The Contractor shall erect and continuously maintain safeguards for the protection of workers and others, and shall post signs and other warnings regarding hazards associated with the construction process, such as protruding fasteners, moving equipment, trenches and holes, scaffolding, window, door or stair openings, and falling materials.

26.4 The Contractor shall restore the premises to conditions that existed prior to the start of the project at areas not intended to be altered according to the Contract Documents.

26.5 The Contractor shall protect existing utilities and exercise care working in the vicinity of utilities shown in the Drawings and Specifications or otherwise located by the Contractor.

26.6 The Contractor shall protect from damage existing trees and other significant plantings and landscape features of the site which will remain a permanent part of the site. If necessary or indicated in the Contract Documents, tree trunks shall be boxed and barriers erected to prevent damage to tree branches or roots.

26.7 The Contractor shall repair or replace damage to the Work caused by the Contractor's or Subcontractor's forces, including that which is reasonably protected, at the expense of the responsible party.

26.8 The Contractor shall not load, or allow to be loaded, any part of the Project with a force which imperils personal or structural safety. The Consultant may consult with the Contractor on such means and methods of construction, however, the ultimate responsibility lies with the Contractor.

26.9 The Contractor shall not jeopardize any work in place with subsequent construction activities such as blasting, drilling, excavating, cutting, patching or altering work. The Consultant must approve altering any structural components of the project. The Contractor shall supervise all construction activities carried out by others on site to ensure that the work is neatly done and in a manner that will not endanger the structure or the component parts.

26.10 The Contractor may act with their sole discretion in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Contractor may negotiate with the Owner for compensation for expenses due to such emergency work.

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- 26.11 The Contractor and Subcontractors shall have no responsibility for the identification, discovery, presence, handling, removal or disposal of, or exposure of persons to, hazardous materials in any form at the project site. The Contractor shall avoid disruption of any hazardous materials or toxic substances at the project site and promptly notify the Owner in writing on the occasion of such a discovery.
- 26.12 The Contractor shall keep the premises free of any unsafe accumulation of waste materials caused by the work. The Contractor shall regularly keep the spaces "broom clean". See the Close-out of the Work provisions of this section regarding cleaning at the completion of the project.

**27. Changes in the Work**

- 27.1 The Contractor shall not proceed with extra work without an approved Change Order or Construction Change Directive. A Change Order which has been properly signed by all parties shall become a part of the contract.
- 27.2 A Change Order is the usual document for directing changes in the Work. In certain circumstances, however, the Owner may utilize a Construction Change Directive to direct the Contractor to perform changes in the Work that are generally consistent with the scope of the project. The Owner shall use a Construction Change Directive only when the normal process for approving changes to the Work has failed to the detriment of the Project, or when agreement on the terms of a Change Order cannot be met, or when an urgent situation requires, in the Owner's judgment, prompt action by the Contractor.
- 27.3 The Consultant shall prepare the Construction Change Directive representing a complete scope of work, with proposed Contract Price and Contract Time revisions, if any, clearly stated.
- 27.4 The Contractor shall promptly carry out a Construction Change Directive which has been signed by the Owner and the Consultant. Work thus completed by the Contractor constitutes the basis for a Change Order. Changes in the Contract Price and Contract Time shall be as defined in the Construction Change Directive unless subsequently negotiated with some other terms.
- 27.5 The method of determining the dollar value of extra work shall be by:
- .1 an estimate of the Contractor accepted by Owner as a lump sum, or
  - .2 unit prices named in the contract or subsequently agreed upon, or
  - .3 cost plus a designated percentage, or
  - .4 cost plus a fixed fee.
- 27.6 The Contractor shall determine the dollar value of the extra work for both the lump sum and cost plus designated percentage methods so as not to exceed the following rates. The rates include all overhead and profit expenses.
- .1 Contractor - for any work performed by the Contractor's own forces, up to 20% of the cost;
  - .2 Subcontractor - for work performed by Subcontractor's own forces, up to 20% of the cost;
  - .3 Contractor - for work performed by Contractor's Subcontractor, up to 10% of the amount due the Subcontractor.
- 27.7 The Contractor shall keep and provide records as needed or directed for the cost plus designated percentage method. The Consultant shall review and certify the appropriate amount which

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includes the Contractor's overhead and profit. The Owner shall make payments based on the Consultant's certificate.

- 27.8 Cost reflected in Change Orders shall be limited to the following: cost of materials, cost of delivery, cost of labor (including Social Security, pension, Workers' Compensation insurance, and unemployment insurance), and cost of rental of power tools and equipment. Labor cost may include a pro-ratio share of a foreman's time only in the case of an extension of contract time granted due to the Change Order.
- 27.9 Overhead reflected in Change Orders shall be limited to the following: bond premium, supervision, wages of clerks, time keepers, and watchmen, small tools, incidental expenses, general office expenses, and all other overhead expenses directly related to the Change Order.
- 27.10 The Contractor shall provide credit to the Owner for labor, materials, equipment and other costs but not overhead and profit expenses for those Change Order items that result in a net value of credit to the contract.
- 27.11 The Owner may change the scope of work of the Project without invalidating the contract. The Owner shall notify the Contractor of a change of the scope of work for the Owner's Contractors, which may affect the work of this Contractor, without invalidating the contract. Change Orders for extension of the time caused by such changes shall be developed at the time of directing the change in scope of work.
- 27.12 The Consultant may order minor changes in the Work, not involving extra cost, which is consistent with the intent of the design or project.
- 27.13 The Contractor shall immediately give written notification to the Consultant of latent conditions discovered at the site which materially differ from those represented in the Drawings or Specifications, and which may eventually result in a change in the scope of work. The Contractor shall suspend work until receiving direction from the Consultant. The Consultant shall promptly investigate the conditions and respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the discovered conditions warrant a Change Order.
- 27.14 The Contractor shall, within ten calendar days of receipt of the information, give written notification to the Consultant if the Contractor claims that instructions by the Consultant will constitute extra cost not accounted for by Change Order or otherwise under the contract. The Consultant shall promptly respond to the Contractor's notice with direction that avoids any unnecessary delay of the Work. The Consultant shall determine if the Contractor's claim warrants a Change Order.

**28. Correction of the Work**

- 28.1 The Contractor shall promptly remove from the premises all work the Consultant declares is non-conforming to the contract. The Contractor shall replace the work properly at no expense to the Owner. The Contractor is also responsible for the expenses of others whose work was damaged or destroyed by such remedial work.

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- 28.2 The Owner may elect to remove non-conforming work if it is not removed by the Contractor within a reasonable time, that time defined in a written notice from the Consultant. The Owner may elect to store removed non-conforming work not removed by the Contractor at the Contractor's expense. The Owner may, with ten days written notice, dispose of materials which the Contractor does not remove. The Owner may sell the materials and apply the net proceeds, after deducting all expenses, to the costs that should have been borne by the Contractor.
- 28.3 The Contractor shall remedy any defects due to faulty materials or workmanship and pay for any related damage to other work which appears within a period of one year from the date of substantial completion, and in accord with the terms of any guarantees provided in the contract. The Owner shall promptly give notice of observed defects to the Contractor and Consultant. The Consultant shall determine the status of all claimed defects. The Contractor shall perform all remedial work without unjustifiable delay in either the initial response or the corrective action.
- 28.4 The Consultant may authorize, after a reasonable notification to the Contractor, an equitable deduction from the contract amount in lieu of the Contractor correcting non-conforming or defective work.
29. Owner's Right to do Work
- 29.1 The Owner may, using other contractors, correct deficiencies attributable to the Contractor, or complete unfinished work. Such action shall take place only after giving the Contractor three days written notice, and provided the Consultant approves of the proposed course of action as an appropriate remedy. The Owner may then deduct the cost of the remedial work from the amount due the Contractor.
- 29.2 The Owner may act with their sole discretion when the Contractor is unable to take action in emergency situations that potentially effect health, life or serious damage to the premises or adjacent properties, to prevent such potential loss or injury. The Owner shall inform the Contractor of the emergency work performed, particularly where it may affect the work of the Contractor.
30. Termination of Contract and Stop Work Action
- 30.1 The Owner may, owing to a certificate of the Consultant indicating that sufficient cause exists to justify such action, without prejudice to any other right or remedy and after giving the Contractor and the Contractor's surety seven days written notice, terminate the employment of the Contractor. At that time the Owner may take possession of the premises and of all materials,

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tools and appliances on the premises and finish the work by whatever method the Owner may deem expedient. Cause for such action by the Owner includes:

- .1 the contractor is adjudged bankrupt, or makes a general assignment for the benefit of its creditors, or
- .2 a receiver is appointed due to the Contractor's insolvency, or
- .3 the Contractor persistently or repeatedly refuses or fails to provide enough properly skilled workers or proper materials, or
- .4 the Contractor fails to make prompt payment to Subcontractors or suppliers of materials or labor, or
- .5 the Contractor persistently disregards laws, ordinances or the instructions of the Consultant, or is otherwise found guilty of a substantial violation of a provision of the Contract Documents.

30.2 The Contractor is not entitled, as a consequence of the termination of the employment of the Contractor as described above, to receive any further payment until the Work is finished. If the unpaid balance of the contract amount exceeds the expense of finishing the Work, including compensation for additional architectural, managerial and administrative services, such balance shall be paid to the Contractor. If the expense of finishing the Work exceeds the unpaid balance, the Contractor shall pay the difference to the Owner. The Consultant shall certify the expense incurred by the Contractor's default. This obligation for payment shall continue to exist after termination of the contract.

30.3 The Contractor may, if the Work is stopped by order of any court or other public authority for a period of thirty consecutive days, and through no act or fault of the Contractor or of anyone employed by the Contractor, with seven days written notice to the Owner and the Consultant, terminate this contract. The Contractor may then recover from the Owner payment for all work executed, any proven loss and reasonable profit and damage.

30.4 The Contractor may, if the Consultant fails to issue a certificate for payment within seven days after the Contractor's formal request for payment, through no fault of the Contractor, or if the Owner fails to pay to the Contractor within 30 days after submission of any sum certified by the Consultant, with seven days written notice to the Owner and the Consultant, stop the Work or terminate this Contract.

### 31. Delays and Extension of Time

31.1 The completion date of the contract shall be extended if the work is delayed by changes ordered in the work which have approved time extensions, or by an act or neglect of the Owner, the Consultant, or the Owner's Contractor, or by strikes, lockouts, fire, flooding, unusual delay in transportation, unavoidable casualties, or by other causes beyond the Contractor's control. The Consultant shall determine the status of all claimed causes.

31.2 The contract shall not be extended for delay occurring more than seven calendar days before the Contractor's claim made in writing to the Consultant. In case of a continuing cause of delay, only one claim is necessary.

31.3 The contract shall not be extended due to failure of the Consultant to furnish drawings if no schedule or agreement is made between the Contractor and the Consultant indicating the dates

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which drawings shall be furnished and fourteen calendar days has passed after said date for such drawings.

- 31.4 This article does not exclude the recovery of damages for delay by either party under other provisions in the Contract Document.

**32. Payments to the Contractor**

- 32.1 As noted under *Preconstruction Conference* in this section, the Contractor shall submit a Schedule of Values form, before the first application for payment, for approval by the Owner and Consultant. The Consultant may direct the Contractor to provide evidence that supports the correctness of the form. The approved Schedule of Values shall be used as a basis for payments.
- 32.2 The Contractor shall submit an application for each payment ("Requisition for Payment") on a form approved by the Owner and Consultant. The Consultant may require receipts or other documents showing the Contractor's payments for materials and labor, including payments to Subcontractors.
- 32.3 The Contractor shall submit Requisitions for Payment as the work progresses not more frequently than once each month, unless the Owner approves a more frequent interval due to unusual circumstances. The Requisition for Payment is based on the proportionate quantities of the various classes of work completed or incorporated in the Work, in agreement with the actual progress of the Work and the dollar value indicated in the Schedule of Values.
- 32.4 The Consultant shall verify and certify each Requisition for Payment which appears to be complete and correct prior to payment being made by the Owner. The Consultant may certify an appropriate amount for materials not incorporated in the Work which have been delivered and suitably stored at the site. The Contractor shall submit bills of sale, insurance certificates, or other such documents that will adequately protect the Owner's interests prior to payments being certified.
- 32.5 In the event any materials delivered but not yet incorporated in the Work have been included in a certified Requisition for Payment with payment made, and said materials thereafter are damaged, deteriorated or destroyed, or for any reason whatsoever become unsuitable or unavailable for use in the Work, the full amount previously allowed shall be deducted from subsequent payments unless the Contractor satisfactorily replaces said material.
- 32.6 The Contractor may request certification of an appropriate dollar amount for materials not incorporated in the Work which have been delivered and suitably stored away from the site. The Contractor shall submit bills of sale, insurance certificates, right-of-entry documents or other such documents that will adequately protect the Owner's interests. The Consultant shall determine if the Contractor's documentation for the materials is complete and specifically designated for the Project. The Owner may allow certification of such payments.
- 32.7 Subcontractors may request, and shall receive from the Consultant, copies of approved Requisitions for Payment showing the amounts certified in the Schedule of Values.
- 32.8 Certified Requisitions for Payment, payments made to the Contractor, or partial or entire occupancy of the project by the Owner shall not constitute an acceptance of any work that does



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not conform to the Contract Documents. The making and acceptance of the final payment constitutes a waiver of all claims by the Owner, other than those arising from unsettled liens, from faulty work or materials appearing within one year from final payment or from requirements of the Drawings and Specifications, and of all claims by the Contractor, except those previously made and still unsettled.

**33. Payments Withheld**

- 33.1 The Owner shall retain five percent of each payment due the Contractor as part security for the fulfillment of the contract by the Contractor. The Owner may make payment of a portion of this “retainage” to the Contractor temporarily or permanently during the progress of the Work. The Owner may thereafter withhold further payments until the full amount of the five percent is reestablished. The Contractor may deposit with the Maine State Treasurer certain securities in place of retainage amounts due according to Maine Statute (5 M.R.S. §1746).
- 33.2 The Consultant may withhold or nullify the whole or a portion of any Requisitions for Payment submitted by the Contractor in the amount that may be necessary, in his reasonable opinion, to protect the Owner from loss due to any of the following:
- .1 defective work not remedied;
  - .2 claims filed or reasonable evidence indicating probable filing of claims;
  - .3 failure to make payments properly to Subcontractors or suppliers;
  - .4 a reasonable doubt that the contract can be completed for the balance then unpaid;
  - .5 liability for damage to another contractor.

The Owner shall make payment to the Contractor, in the amount withheld, when the above circumstances are removed.

**34. Liens**

- 34.1 The Contractor shall deliver to the Owner a complete release of all liens arising out of this contract before the final payment or any part of the retainage payment is released. The Contractor shall provide with the release of liens an affidavit asserting each release includes all labor and materials for which a lien could be filed. Alternately, the Contractor, in the event any Subcontractor or supplier refuses to furnish a release of lien in full, may furnish a bond satisfactory to the Owner, to indemnify the Owner against any lien.
- 34.2 In the event any lien remains unsatisfied after all payments to the Contractor are made by the Owner, the Contractor shall refund to the Owner all money that the latter may be compelled to pay in discharging such lien, including all cost and reasonable attorney’s fees.

**35. Workmanship**

- 35.1 The Contractor shall provide materials, equipment, and installed work equal to or better than the quality specified in the Contract Documents and approved in submittal and sample. The installation methods shall be of the highest standards, and the best obtainable from the respective trades. The Consultant’s decision on the quality of work shall be final.

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- 35.2 The Contractor shall know local labor conditions for skilled and unskilled labor in order to apply the labor appropriately to the Work. All labor shall be performed by individuals well skilled in their respective trades.
- 35.3 The Contractor shall perform all cutting, fitting, patching and placing of work in such a manner to allow subsequent work to fit properly, whether that be by the Contractor, the Owner's Contractors or others. The Owner and Consultant may advise the Contractor regarding such subsequent work. Notwithstanding the notification or knowledge of such subsequent work, the Contractor may be directed to comply with this standard of compatible construction by the Consultant at the Contractor's expense.
- 35.4 The Contractor shall request clarification or revision of any design work by the Consultant, prior to commencing that work, in a circumstance where the Contractor believes the work cannot feasibly be completed at the highest quality, or as indicated in the Contract Documents. The Consultant shall respond to such requests in a timely way, providing clarifying information, a feasible revision, or instruction allowing a reduced quality of work. The Contractor shall follow the direction of the Consultant regarding the required request for information.
- 35.5 The Contractor shall guarantee the Work against any defects in workmanship and materials for a period of one year commencing with the date of the Certificate of Substantial Completion, unless specified otherwise for specific elements of the project. The Work may also be subdivided in mutually agreed upon components, each defined by a separate Certificate of Substantial Completion.
36. Close-out of the Work
- 36.1 The Contractor shall remove from the premises all waste materials caused by the work. The Contractor shall make the spaces "broom clean" unless a more thorough cleaning is specified. The Contractor shall clean all windows and glass immediately prior to the final inspection, unless otherwise directed.
- 36.2 The Owner may conduct the cleaning of the premises where the Contractor, duly notified by the Consultant, fails to adequately complete the task. The expense of this cleaning may be deducted from the sum due to the Contractor.
- 36.3 The Contractor shall participate in all final inspections and acknowledge the documentation of unsatisfactory work, customarily called the "punch list", to be corrected by the Contractor. The Consultant shall document the successful completion of the Work in a dated Certificate of Substantial Completion, to be signed by Owner, Consultant, and Contractor.
- 36.4 The Contractor shall not call for final inspection of any portion of the Work that is not completely and permanently installed. The Contractor may be found liable for the expenses of individuals called to final inspection meetings prematurely.
- 36.5 The Contractor and all major Subcontractors shall participate in the end-of-warranty-period conference, typically scheduled close to one year after the Substantial Completion date.

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**37. Date of Completion and Liquidated Damages**

- 37.1 The Contractor may make a written request to the Owner for an extension or reduction of time, if necessary. The request shall include the reasons the Contractor believes justifies the proposed completion date. The Owner may grant the revision of the contract completion date if the Work was delayed due to conditions beyond the control and the responsibility of the Contractor. The Contractor shall not conduct unauthorized accelerated work or file delay claims to recover alleged damages for unauthorized early completion.
- 37.2 The Contractor shall vigorously pursue the completion of the Work and notify the Owner of any factors that have, may, or will affect the approved Schedule of the Work. The Contractor may be found responsible for expenses of the Owner or Consultant if the Contractor fails to make notification of project delays.
- 37.3 The Project is planned to be done in an orderly fashion which allows for an iterative submittal review process, construction administration including minor changes in the Work and some bad weather. The Contractor shall not file delay claims to recover alleged damages on work the Consultant determines has followed the expected rate of progress.
- 37.4 The Consultant shall prepare the Certificate of Substantial Completion which, when signed by the Owner and the Contractor, documents the date of Substantial Completion of the Work or a designated portion of the Work. The Owner shall not consider the issuance of a Certificate of Occupancy by an outside authority a prerequisite for Substantial Completion if the Certificate of Occupancy cannot be obtained due to factors beyond the Contractor's control.
- 37.5 Liquidated Damages may be deducted from the sum due to the Contractor for each calendar day that the Work remains uncompleted after the completion date specified in the Contract or an approved amended completion date. The dollar amount per day shall be calculated using the Schedule of Liquidated Damages table shown below.

If the original contract amount is:	The per day Liquidated Damages shall be:
Less than \$100,000	\$250
\$100,000 to less than \$2,000,000	\$750
\$2,000,000 to less than \$10,000,000	\$1,500
\$10,000,000 and greater	\$1,500 plus \$250 for each \$2,000,000 over \$10,000,000

**38. Dispute Resolution**

**38.1 Mediation**

- 38.1.1 A dispute between the parties which arises under this Contract which cannot be resolved through informal negotiation, shall be submitted to a neutral mediator jointly selected by the parties.
- 38.1.2 Either party may file suit before or during mediation if the party, in good faith, deems it to be necessary to avoid losing the right to sue due to a statute of limitations. If suit is filed before good faith mediation efforts are completed, the party filing suit shall agree to stay all proceedings in the lawsuit pending completion of the mediation process, provided such stay is without prejudice.

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**General Conditions**

38.1.3 In any mediation between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

38.2 Arbitration

38.2.1 If the dispute is not resolved through mediation, the dispute shall be settled by arbitration. The arbitration shall be conducted before a panel of three arbitrators. Each party shall select one arbitrator; the third arbitrator shall be appointed by the arbitrators selected by the parties. The arbitration shall be conducted in accordance with the Maine Uniform Arbitration Act (MUAA), except as otherwise provided in this section.

38.2.2 The decision of the arbitrators shall be final and binding upon all parties. The decision may be entered in court as provided in the MUAA.

38.2.3 The costs of the arbitration, including the arbitrators' fees shall be borne equally by the parties to the arbitration, unless the arbitrator orders otherwise.

38.2.4 In any arbitration between the Owner and the Consultant, the Owner has the right to consolidate related claims between Owner and Contractor.

**00 73 46**  
**Wage Determination Schedule**

**PART 1- GENERAL**

**1.1 Related Documents**

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

**1.2 Summary**

- A. This Section includes the wage determination requirements for Contractors as issued by the State of Maine Department of Labor Bureau of Labor Standards or the United States Department of Labor.

**1.3 Requirements**

- A. Conform to the wage determination schedule for this project which is shown on the following page.

**PART 2 - PRODUCTS (not used)**

**PART 3 - EXECUTION (not used)**

**00 73 46**  
**Wage Determination Schedule**

**2025 Fair Minimum Wage Rates – Building 2 Aroostook County (other than 1 or 2 family homes)**

<b>Occupational Title</b>	<b>Minimum Wage</b>	<b>Minimum Benefit</b>	<b>Total</b>
Brickmasons And Blockmasons	\$38.00	\$3.75	\$41.75
Bulldozer Operator	\$34.44	\$2.21	\$36.65
Carpenter	\$32.59	\$2.86	\$35.45
Cement Masons And Concrete Finisher	\$26.00	\$0.00	\$26.00
Construction And Maintenance Painters	\$26.25	\$0.49	\$26.74
Construction Laborer	\$24.00	\$1.20	\$25.20
Crane And Tower Operators	\$34.50	\$10.68	\$45.18
Crushing Grinding And Polishing Machine Operators	\$27.50	\$5.64	\$33.14
Earth Drillers - Except Oil And Gas	\$23.30	\$0.99	\$24.29
Electrical Power - Line Installer And Repairers	\$43.26	\$16.55	\$59.81
Electricians	\$38.50	\$5.29	\$43.79
Elevator Installers And Repairers	\$71.21	\$43.75	\$114.96
Excavator Operator	\$31.38	\$5.83	\$37.21
Fence Erectors	\$20.00	\$1.23	\$21.23
Flaggers	\$20.50	\$0.40	\$20.90
Floor Layers - Except Carpet/Wood/Hard Tiles	\$26.50	\$3.83	\$30.33
Glaziers	\$21.00	\$2.39	\$23.39
Grader/Scraper Operator	\$31.00	\$6.86	\$37.86
Hazardous Materials Removal Workers	\$21.13	\$1.14	\$22.27
Heating And Air Conditioning And Refrigeration Mechanics And Installers	\$34.13	\$5.63	\$39.76
Heavy And Tractor - Trailer Truck Drivers	\$22.75	\$1.12	\$23.87
Highway Maintenance Workers	\$22.85	\$4.79	\$27.64
Industrial Machinery Mechanics	\$30.00	\$4.60	\$34.60
Industrial Truck And Tractor Operators	\$26.17	\$3.49	\$29.66
Insulation Worker - Mechanical	\$24.00	\$5.97	\$29.97
Ironworker - Ornamental	\$31.37	\$25.82	\$57.19
Light Truck Or Delivery Services Drivers	\$27.99	\$2.02	\$30.01
Loading Machine And Dragline Operators	\$25.50	\$4.99	\$30.49
Millwrights	\$31.45	\$15.17	\$46.62
Mobile Heavy Equipment Mechanics - Except Engines	\$30.00	\$5.67	\$35.67
Operating Engineers And Other Equipment Operators	\$28.50	\$3.54	\$32.04
Paving Surfacing And Tamping Equipment Operators	\$28.60	\$12.03	\$40.63
Pile-Driver Operators	\$36.00	\$2.87	\$38.87
Pipe/Steam/Sprinkler Fitter	\$38.75	\$22.96	\$61.71
Pipelayers	\$27.48	\$4.72	\$32.20
Plumbers	\$32.00	\$6.69	\$38.69
Pump Operators - Except Wellhead Pumpers	\$56.03	\$34.76	\$90.79
Radio Cellular And Tower Equipment Installers	\$30.00	\$4.85	\$34.85
Reinforcing Iron And Rebar Workers	\$56.69	\$2.27	\$58.96
Riggers	\$30.50	\$8.25	\$38.75
Roofers	\$24.00	\$3.60	\$27.60
Sheet Metal Workers	\$25.00	\$6.21	\$31.21
Structural Iron And Steel Workers	\$32.02	\$24.67	\$56.69
Tapers	\$28.00	\$2.40	\$30.40
Telecommunications Equipment Installers And Repairers - Except Line Installers	\$33.44	\$6.87	\$40.31
Telecommunications Line Installers And Repairers	\$29.50	\$1.96	\$31.46

**Welders are classified as the trade to which welding is incidental (e.g. welding structural steel is Structural Iron and Steel Worker)**

**Apprentices – The minimum wage rates for registered apprentices are the rates recognized in the sponsorship agreement for registered apprentices working in the pertinent classification.**

**For any other specific trade on this project not listed above, contact the Bureau of Labor Standards for further clarification.**

End of Section 00 73 46



# TECHNICAL SPECIFICATIONS



## SECTION 01 10 00

### SUMMARY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Contract description.
  - 2. Work by Owner or other Work at the Site.
  - 3. Owner-furnished products.
  - 4. Contractor's use of Site and premises.
  - 5. Future work.
  - 6. Work sequence.
  - 7. Owner occupancy.
  - 8. Permits.
  - 9. Specification conventions.

##### 1.2 CONTRACT DESCRIPTION

- A. Work of the Project includes alteration and renovation to the following features at the Connor School in Connor Township, Maine:
  - 1. Site/Civil
    - a. Capping/decommissioning of existing well.
    - b. Provision of a new well and associated piping to connect with building plumbing system.
    - c. Repaving and restriping of existing parking lot.
    - d. Provision of additional spaces at existing parking lot.
    - e. Provision of new, fenced dumpster pad.
    - f. Provision of new asphalt paved sidewalks at renovated building entrance.
    - g. Provision of new concrete plaza at renovated building entrance.
    - h. Provision of new fenced enclosure with entrances at existing playground.
    - i. Provision of new site lighting at paved apron around the building.
    - j. Provision of handrail at south building entrance ramp.
    - k. Provision of miscellaneous regrading and stone maintenance edge around the building as indicated on the Drawings.
  - 2. Architectural
    - a. Removal of existing building features as indicated on the Demolition Plans.
    - b. Construction of a new building entrance vestibule and adjacent administrative offices addition. Addition includes the following features:
      - 1) New concrete foundations and floor slabs at the addition.
      - 2) Exterior walls are masonry veneer/block backup cavity wall construction.
      - 3) Bullet resistant block wall with bullet resistant transaction window between Front Office and Entrance Vestibule.
      - 4) Wood stud/GWB partition walls between interior rooms and at interior faces of masonry walls.





- 5) New storefront system at Entrance Vestibule exterior and interior openings.
  - 6) New doors and windows as indicated on the drawings.
  - 7) New steel support columns as indicated on the drawings.
  - 8) Roof structure composed of wood structural framing, wood girder trusses, and plywood decking as indicated on the drawings.
  - 9) New EPDM membrane roof over tapered rigid insulation panels at addition. Taper insulation to interface with existing roof system.
  - c. Renovation of existing staff office to be a new Staff Break Room.
    - 1) New base and wall cabinets in Staff Break Room.
    - 2) Installation of new Refrigerator (OS/CI) in Staff Break Room.
    - 3) Installation of new sink and casework in Staff Break Room.
    - 4) Installation of new floors in Staff Break Room.
3. Plumbing
- a. Replace the existing water heater with a new heat pump hybrid water heater.
  - b. Replace existing floor drain traps with new traps to connect new trap primer piping.
  - c. Install new trap primer unit in Janitor's closet and piping to/from bathroom floor drains, see plans for extent of piping and connection points.
4. Mechanical
- a. Demolition of existing ductwork, piping, and equipment as indicated on MEP Demolition Plans.
  - b. Replacement of existing boilers.
  - c. Provision of new ERV units and associated ductwork and piping in existing Classrooms, the existing Library, the new addition, and the existing Multipurpose Room.
  - d. Provision of new VRF Heat Pump Units as indicated on MEP Drawings.
  - e. New controls and thermostats for the building mechanical system.
  - f. Miscellaneous Electric Unit Heaters and hydronic kickspace heaters in the new Entrance Vestibule and Staff Break Room.
5. Electrical
- a. Installation of new 120/208V/3-Phase electrical service with all required accessories and indicated on the MEP Drawings.
  - b. Replacement of existing MDP and Sub Panels with new units as indicated on the MEP Drawings.
  - c. Replacement of existing lighting with new LED units and installation of new LED lighting, as indicated on the MEP Drawings.
  - d. Provision of new site lighting, as indicated on the Site/Civil and MEP Drawings.
  - e. Demolition and replacement of existing equipment circuits and provision of new equipment circuits as indicated on the MEP Drawings.
  - f. Provision of new Receptacle circuits in the addition and breakroom as shown on the MEP Drawings.
  - g. Provision of new Fire Alarm devices in the addition, connect devices into existing Fire Alarm system. Relocate existing devices as required for addition modifications.



### 1.3 OWNER-FURNISHED PRODUCTS

- A. Owner's Responsibilities:
  - 1. Arrange for and deliver Owner-reviewed Shop Drawings, Product Data, and Samples to Contractor.
  - 2. Arrange and pay for delivery to Site.
  - 3. Upon delivery, inspect products jointly with Contractor.
  - 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
  - 5. Arrange for manufacturers' warranties, inspections, and service.
- B. Contractor's Responsibilities:
  - 1. Review Owner-reviewed Shop Drawings, Product Data, and Samples.
  - 2. Receive and unload products at Site; inspect for completeness or damage jointly with Owner.
  - 3. Handle, store, install, and finish products.
  - 4. Repair or replace items damaged after receipt.
- C. Items furnished by Owner for installation by Contractor:
  - 1. New Refrigerator in the Staff Break Room.

### 1.4 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Limit use of Site and premises to allow:
  - 1. Owner occupancy.
  - 2. Use of Site and premises by the public.
- B. Emergency Building Exits during Construction: Provide code compliant exiting during construction.
- C. Construction Operations: Limited to areas indicated on Drawings.
  - 1. Noisy and Disruptive Operations (such as Use of Jack Hammers and Other Noisy Equipment): Not allowed in close proximity to existing building during regular hours of operation. Coordinate and schedule such operations with Owner to minimize disruptions. Coordinate noisy and disruptive operations with Owner and Architect.
- D. Time Restrictions for Performing Interior and Exterior Work: Coordinate with Owner and Architect.
- E. Utility Outages and Shutdown:
  - 1. Coordinate and schedule electrical and other utility outages with Owner.
  - 2. Outages: Allowed only at previously agreed upon times. In general, schedule outages at times when facility is not being used.
  - 3. At least one week before scheduled outage, submit Outage Request Plan to Owner and Architect itemizing the dates, times, and duration of each requested outage.
- F. Construction Plan: Before start of construction, submit three copies of construction plan regarding access to Work, use of Site, and utility outages for acceptance by Owner.



After acceptance of plan, construction operations shall comply with accepted plan unless deviations are accepted by Owner in writing.

#### 1.5 FUTURE WORK

- A. Project is designed for future addition of an emergency generator. Please coordinate work plans with Owner and Architect so that the future installation of this system is accommodated.

#### 1.6 WORK SEQUENCE

- A. Construct Work in order to accommodate Owner's occupancy requirements during construction period. Coordinate construction schedule and operations with Architect/Engineer and Owner:
- B. Sequencing of Construction Plan: Before start of construction, submit three copies of construction plan regarding phasing of demolition, renovation, and new Work for acceptance by Owner. After acceptance of plan, construction sequencing shall comply with accepted plan unless deviations are accepted by Owner in writing.

#### 1.7 OWNER OCCUPANCY

- A. Owner will occupy Site and premises during the regularly scheduled school year for conduct of normal operations.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the Work to accommodate Owner occupancy.

#### 1.8 PERMITS

- A. Furnish all necessary permits for construction of Work including the following:
  - 1. Building permit.
  - 2. Stormwater permit.
  - 3. Dewatering permit.

#### 1.9 SPECIFICATION CONVENTIONS

- A. These Specifications are written in imperative mood and streamlined form. This imperative language is directed to Contractor unless specifically noted otherwise. The words "shall be" are included by inference where a colon (:) is used within sentences or phrases.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 20 00

### PRICE AND PAYMENT PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Cash allowances.
- B. Testing and inspection allowances.
- C. Schedule of Values.
- D. Application for Payment.
- E. Change procedures.
- F. Defect assessment.

##### 1.2 CASH ALLOWANCES

- A. Costs Included in Cash Allowances: Cost of product to Contractor or Subcontractor, less applicable trade discounts; delivery to Site and applicable taxes unless stated otherwise in Allowance Schedule.
- B. Costs Not Included in Cash Allowances but Included in Contract Sum/Price: Product handling at Site including unloading, uncrating, and storage; protection of products from elements and from damage; and labor for installation and finishing unless stated otherwise in Allowance Schedule.
- C. Architect/Engineer Responsibilities:
  - 1. Consult with Contractor for consideration and selection of products, suppliers, and installers.
  - 2. Select products in consultation with Owner and transmit decision to Contractor.
  - 3. Prepare Change Order.
- D. Contractor Responsibilities:
  - 1. Assist Architect/Engineer in selection of products, suppliers, and installers.
  - 2. Obtain proposals from suppliers and installers and offer recommendations.
  - 3. Upon notification of selection by Architect/Engineer, execute purchase agreement with designated supplier and installer.
  - 4. Arrange for and process Shop Drawings, Product Data, and Samples. Arrange for delivery.
  - 5. Promptly inspect products upon delivery for completeness, damage, and defects. Submit claims for transportation damage.
- E. Differences in costs will be adjusted by Change Order.



- F. Allowance Schedule:
  - 1. Allowance #1: Excess Utility Allowance: Include the stipulated sum of \$63,500 for purchase, delivery, and installation work associated with connection to and coordination with site utility systems and providers.

### 1.3 TESTING AND INSPECTION ALLOWANCES

- A. Costs Included in Testing and Inspecting Allowances:
  - 1. Cost of engaging testing and inspecting agency.
  - 2. Execution of tests and inspecting.
  - 3. Reporting results.
- B. Costs Not Included in Testing and Inspecting Allowance but Included in Contract Sum/Price:
  - 1. Costs of incidental labor and facilities required to assist testing or inspecting agency.
  - 2. Costs of testing services used by Contractor separate from Contract Document requirements.
  - 3. Costs of retesting upon failure of previous tests as determined by Architect/Engineer.
- C. Payment Procedures:
  - 1. Submit one copy of inspecting or testing firm's invoice with next Application for Payment.
  - 2. Pay invoice upon approval by Architect/Engineer.
- D. Testing and Inspecting Allowance Schedule:
  - 1. Allowance #2: Construction Testing Allowance: Include the sum of \$10,000 for payment of testing and inspecting laboratory services specified in Section 01 40 00 – Quality Requirements and in relevant specification Sections.
- E. Differences in cost will be adjusted by Change Order.

### 1.4 SCHEDULE OF VALUES

- A. Submit printed schedule on AIA G703 - Continuation Sheet for G702.
- B. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
- C. Format: Use Table of Contents of this Project Manual. Identify each line item with number and title of major Specification Section. Also identify Site mobilization and bonds and insurance.
- D. Include in each line item amount of allowances as specified in this Section.
- E. Include separately from each line item, direct proportional amount of Contractor's overhead and profit.
- F. Revise schedule to list approved Change Orders with each Application for Payment.



## 1.5 APPLICATION FOR PAYMENT

- A. Submit three copies of each Application for Payment on AIA G702 - Application and Certificate for Payment and AIA G703 - Continuation Sheet for G702.
- B. Content and Format: Use Schedule of Values for listing items in Application for Payment.
- C. Submit updated construction schedule with each Application for Payment.
- D. Payment Period: Submit at intervals stipulated in the Agreement.
- E. Submit submittals with transmittal letter as specified in Section 01 33 00 - Submittal Procedures.
- F. Submit three copies of waivers requested by Owner.
- G. Substantiating Data: When Architect/Engineer requires substantiating information, submit data justifying dollar amounts in question. Include the following with Application for Payment:
  - 1. Partial release of liens from major Subcontractors and vendors.
  - 2. Record Documents as specified in Section 01 70 00 - Execution and Closeout Requirements, for review by Owner, which will be returned to Contractor.
  - 3. Affidavits attesting to off-Site stored products.
  - 4. Construction Progress Schedule, revised and current as specified in Section 01 33 00 - Submittal Procedures.

## 1.6 CHANGE PROCEDURES

- A. Submittals: Submit name of individual who is authorized to receive change documents and is responsible for informing others in Contractor's employ or Subcontractors of changes to the Work.
- B. Carefully study and compare Contract Documents before proceeding with fabrication and installation of Work. Promptly advise Architect/Engineer of any error, inconsistency, omission, or apparent discrepancy.
- C. Requests for Interpretation (RFI) and Clarifications: Allot time in construction scheduling for liaison with Architect/Engineer; establish procedures for handling queries and clarifications.
  - 1. Use AIA G716 - Request for Information for requesting interpretations.
  - 2. Architect/Engineer may respond with a direct answer on the Request for Interpretation form, AIA G709 - Work Changes Proposal Request].
- D. Architect/Engineer will advise of minor changes in the Work not involving adjustment to Contract Sum/Price or Contract Time by issuing supplemental instructions on AIA G710.
- E. Architect/Engineer may issue AIA G709 including a detailed description of proposed change with supplementary or revised Drawings and Specifications, a change in Contract Time for executing the change with stipulation of overtime work required and



with the period of time during which the requested price will be considered valid. Contractor will prepare and submit estimate within 10 days.

- F. Contractor may propose changes by submitting a request for change to Architect/Engineer, describing proposed change and its full effect on the Work. Include a statement describing reason for the change and the effect on Contract Sum/Price and Contract Time with full documentation.
  - G. Document requested substitutions according to Section 01 25 00 - Substitution Procedures.
  - H. Stipulated Sum/Price Change Order: Based on AIA G709 and Contractor's fixed price quotation or Contractor's request for Change Order as approved by Architect/Engineer.
  - I. Construction Change Directive: Architect/Engineer may issue directive, on AIA G714 - Construction Change Directive signed by Owner, instructing Contractor to proceed with change in the Work, for subsequent inclusion in a Change Order. Document will describe changes in the Work and designate method of determining any change in Contract Sum/Price or Contract Time. Promptly execute change.
  - J. Time and Material Change Order: Submit itemized account and supporting data after completion of change, within time limits indicated in Conditions of the Contract. Architect/Engineer will determine change allowable in Contract Sum/Price and Contract Time as provided in Contract Documents.
  - K. Maintain detailed records of Work done on time and material basis. Provide full information required for evaluation of proposed changes and to substantiate costs for changes in the Work.
  - L. Document each quotation for change in Project Cost or Time with sufficient data to allow evaluation of quotation.
  - M. Change Order Forms: AIA G701 - Change Order.
  - N. Execution of Change Orders: Architect/Engineer will issue Change Orders for signatures of parties as provided in Conditions of the Contract.
  - O. Correlation of Contractor Submittals:
    - 1. Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as separate line item and adjust Contract Sum/Price.
    - 2. Promptly revise Progress Schedules to reflect change in Contract Time, revise sub schedules to adjust times for other items of Work affected by the change, and resubmit.
    - 3. Promptly enter changes in Record Documents.
- 1.7 DEFECT ASSESSMENT
- A. Replace the Work, or portions of the Work, not conforming to specified requirements.
  - B. If, in the opinion of Architect/Engineer, it is not practical to remove and replace the Work, Architect/Engineer will direct appropriate remedy or adjust payment.



- C. The defective Work may remain, but unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.
- D. Defective Work will be partially repaired according to instructions of Architect/Engineer, and unit sum/price will be adjusted to new sum/price at discretion of Architect/Engineer.
- E. Individual Specification Sections may modify these options or may identify specific formula or percentage sum/price reduction.
- F. Authority of Architect/Engineer to assess defects and identify payment adjustments is final.
- G. Nonpayment for Rejected Products: Payment will not be made for rejected products for any of the following reasons:
  - 1. Products wasted or disposed of in a manner that is not acceptable.
  - 2. Products determined as unacceptable before or after placement.
  - 3. Products not completely unloaded from transporting vehicle.
  - 4. Products placed beyond lines and levels of the required Work.
  - 5. Products remaining on hand after completion of the Work.
  - 6. Loading, hauling, and disposing of rejected products.

PRODUCTS - Not Used

PART 2 - EXECUTION - Not Used

END OF SECTION





## SECTION 01 25 00

### SUBSTITUTION PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality assurance.
- B. Product options.
- C. Product substitution procedures.

##### 1.2 QUALITY ASSURANCE

- A. Contract is based on products and standards established in Contract Documents without consideration of proposed substitutions.
- B. Products specified define standard of quality, type, function, dimension, appearance, and performance required.
- C. Substitution Proposals: Permitted for specified products except where specified otherwise. Do not substitute products unless substitution has been accepted and approved in writing by Owner.

##### 1.3 PRODUCT OPTIONS

- A. See Section 01 60 00 - Product Requirements.

##### 1.4 PRODUCT SUBSTITUTION PROCEDURES

- A. Document 00 21 13 - Instructions to Bidders specifies time restrictions for submitting requests for substitutions during Bidding period.
- B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.
- C. Document each request with complete data, substantiating compliance of proposed substitution with Contract Documents, including:
  - 1. Manufacturer's name and address, product, trade name, model, or catalog number, performance and test data, and reference standards.
  - 2. Itemized point-by-point comparison of proposed substitution with specified product, listing variations in quality, performance, and other pertinent characteristics.
  - 3. Reference to Article and Paragraph numbers in Specification Section.
  - 4. Cost data comparing proposed substitution with specified product and amount of net change to Contract Sum.
  - 5. Changes required in other Work.
  - 6. Availability of maintenance service and source of replacement parts as applicable.
  - 7. Certified test data to show compliance with performance characteristics specified.
  - 8. Samples when applicable or requested.



9. Other information as necessary to assist Architect/Engineer's evaluation.
- D. A request constitutes a representation that Bidder or Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
  2. Will provide same warranty for substitution as for specified product.
  3. Will coordinate installation and make changes to other Work that may be required for the Work to be complete with no additional cost to Owner.
  4. Waives claims for additional costs or time extension that may subsequently become apparent.
  5. Will coordinate installation of the accepted substitute, making such changes as may be required for the Work to be complete in all respects.
  6. Will reimburse Owner and Architect/Engineer for review or redesign services associated with reapproval by authorities having jurisdiction.
- E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals without separate written request or when acceptance will require revision to Contract Documents.
- F. Substitution Submittal Procedure:
1. Submit requests for substitutions on CSI Form 13.1A Substitution Request-After the Bidding/Negotiating Stage.
  2. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
  3. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
  4. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.
- 1.5 INSTALLER SUBSTITUTION PROCEDURES
- A. Document 00 21 13 - Instructions to Bidders specifies time restrictions for submitting requests for substitutions during Bidding period.
- B. Document each request with:
1. Installer's qualifications.
  2. Installer's experience in work similar to that specified.
  3. Other information as necessary to assist Architect/Engineer's evaluation.
- C. Substitution Submittal Procedure:
1. Submit three copies of Request for Substitution for consideration. Limit each request to one proposed substitution.
  2. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 30 00

### ADMINISTRATIVE REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Coordination and Project conditions.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Preinstallation meetings.
- E. Closeout meeting.
- F. Alteration procedures.

##### 1.2 COORDINATION AND PROJECT CONDITIONS

- A. Coordinate scheduling, submittals, and Work of various Sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- B. Verify that utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate Work of various Sections having interdependent responsibilities for installing, connecting to, and placing operating equipment in service.
- C. Coordinate space requirements, supports, and installation of mechanical and electrical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practical; place runs parallel with lines of building. Use spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
  - 1. Coordination Drawings: Prepare as required to coordinate all portions of Work. Show relationship and integration of different construction elements that require coordination during fabrication or installation to fit in space provided or to function as intended. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are important.
- D. Coordination Meetings: In addition to other meetings specified in this Section, hold coordination meetings with personnel and Subcontractors to ensure coordination of Work.
- E. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.



- F. Coordinate completion and clean-up of Work of separate Sections in preparation for Substantial Completion and for portions of Work designated for Owner's occupancy.
- G. After Owner's occupancy of premises, coordinate access to Site for correction of defective Work and Work not complying with Contract Documents, to minimize disruption of Owner's activities.

### 1.3 PRECONSTRUCTION MEETING

- A. Architect/Engineer will schedule and preside over meeting after Notice to Proceed.
- B. Attendance Required: Architect/Engineer, Owner, Resident Project Representative, appropriate governmental agency representatives, major Subcontractors, and Contractor.
- C. Minimum Agenda:
  - 1. Execution of Owner-Contractor Agreement.
  - 2. Submission of executed bonds and insurance certificates.
  - 3. Distribution of Contract Documents.
  - 4. Submission of list of Subcontractors, list of products, schedule of values, and Progress Schedule.
  - 5. Designation of personnel representing parties in Contract and Architect/Engineer.
  - 6. Communication procedures.
  - 7. Procedures and processing of requests for interpretations, field decisions, submittals, substitutions, Applications for Payments, proposal request, Change Orders, and Contract closeout procedures.
  - 8. Scheduling.
  - 9. Critical Work sequencing.
  - 10. Scheduling activities of Geotechnical Engineer.
- D. Contractor: Record minutes and distribute copies to participants within two days after meeting, with two copies each to Architect/Engineer, Owner, and those affected by decisions made.

### 1.4 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the Work at maximum twice monthly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, and preside over meetings.
- C. Attendance Required: Job superintendent, major Subcontractors and suppliers, and Architect/Engineer, Owner, as appropriate to agenda topics for each meeting.
- D. Minimum Agenda:
  - 1. Review minutes of previous meetings.
  - 2. Review of Work progress.
  - 3. Field observations, problems, and decisions.



4. Identification of problems impeding planned progress.
5. Review of submittal schedule and status of submittals.
6. Review of off-Site fabrication and delivery schedules.
7. Maintenance of Progress Schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on Progress Schedule and coordination.
13. Other business relating to Work.

- E. Contractor: Record minutes and distribute copies to participants within two days after meeting, with two copies each to Architect/Engineer, Owner, and those affected by decisions made.

#### 1.5 PREINSTALLATION MEETINGS

- A. When required in individual Specification Sections, convene preinstallation meetings at Project Site before starting Work of specific Section.
- B. Require attendance of parties directly affecting, or affected by, Work of specific Section.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Prepare agenda and preside over meeting:
1. Review conditions of installation, preparation, and installation procedures.
  2. Review coordination with related Work.
- E. Record minutes and distribute copies to participants within two days after meeting, with two copies each to Architect/Engineer, Owner, and those affected by decisions made.

#### 1.6 CLOSEOUT MEETING

- A. Schedule Project closeout meeting with sufficient time to prepare for requesting Substantial Completion. Preside over meeting and be responsible for minutes.
- B. Attendance Required: Contractor, major Subcontractors, Architect/Engineer, Owner, and others appropriate to agenda.
- C. Notify Architect/Engineer four days in advance of meeting date.
- D. Minimum Agenda:
1. Start-up of facilities and systems.
  2. Operations and maintenance manuals.
  3. Testing, adjusting, and balancing.
  4. System demonstration and observation.
  5. Operation and maintenance instructions for Owner's personnel.
  6. Contractor's inspection of Work.



7. Contractor's preparation of an initial "punch list."
8. Procedure to request Architect/Engineer inspection to determine date of Substantial Completion.
9. Completion time for correcting deficiencies.
10. Inspections by authorities having jurisdiction.
11. Certificate of Occupancy and transfer of insurance responsibilities.
12. Partial release of retainage.
13. Final cleaning.
14. Preparation for final inspection.
15. Closeout Submittals:
  - a. Project record documents.
  - b. Operating and maintenance documents.
  - c. Operating and maintenance materials.
  - d. Affidavits.
16. Final Application for Payment.
17. Contractor's demobilization of Site.
18. Maintenance.

- E. Record minutes and distribute copies to participants within two days after meeting, with two copies each to Architect/Engineer, Owner, and those affected by decisions made.

## PART 2 - PRODUCTS - Not Used

## PART 3 - EXECUTION

### 3.1 ALTERATION PROCEDURES

- A. Entire facility will be occupied for normal operations during progress of construction. Cooperate with Owner in scheduling operations to minimize conflict and to permit continuous usage.
1. Perform Work not to interfere with operations of occupied areas.
  2. Keep utility and service outages to a minimum and perform only after written approval of Owner.
  3. Clean Owner-occupied areas daily. Clean spillage, overspray, and heavy collection of dust in Owner-occupied areas immediately.
- B. Materials: As specified in product Sections; match existing products with new and salvaged products for patching and extending Work.
- C. Employ skilled and experienced installer to perform alteration and renovation Work.
- D. Cut, move, or remove items as necessary for access to alterations and renovation Work. Replace and restore at completion. Comply with Section 017000 - Execution and Closeout Requirements
- E. Remove unsuitable material not marked for salvage, including rotted wood, corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Work.



- F. Remove debris and abandoned items from area and from concealed spaces.
- G. Prepare surface and remove surface finishes to permit installation of new Work and finishes.
- H. Close openings in exterior surfaces to protect existing Work from weather and extremes of temperature and humidity.
- I. Remove, cut, and patch Work to minimize damage and to permit restoring products and finishes to original or specified condition.
- J. Refinish existing visible surfaces to remain in renovated rooms and spaces, to specified condition for each material, with neat transition to adjacent finishes.
- K. Where new Work abuts or aligns with existing Work, provide smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- L. When finished surfaces are cut so that smooth transition with new Work is not possible, terminate existing surface along straight line at natural line of division and submit recommendation to Architect/Engineer for review.
- M. Where change of plane of 1/4 inch or more occurs, submit recommendation for providing smooth transition to Architect/Engineer for review.
- N. Trim existing doors to clear new floor finish. Refinish trim to original or specified condition.
- O. Patch or replace portions of existing surfaces that are damaged, lifted, discolored, or showing other imperfections.
- P. Finish surfaces as specified in individual product Sections.

END OF SECTION



## SECTION 01 32 16

### CONSTRUCTION PROGRESS SCHEDULE

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Submittals.
- B. Bar chart schedules.
- C. Review and evaluation.
- D. Updating schedules.
- E. Distribution.

##### 1.2 SUBMITTALS

- A. Schedule Updates:
  - 1. Overall percent complete, projected and actual.
  - 2. Completion progress by listed activity and subactivity, to within five working days prior to submittal.
  - 3. Changes in Work scope and activities modified since submittal.
  - 4. Delays in submittals or resubmittals, deliveries, or Work.
  - 5. Adjusted or modified sequences of Work.
  - 6. Other identifiable changes.
  - 7. Revised projections of progress and completion.
- B. Narrative Progress Report:
  - 1. Submit with each monthly submission of Progress Schedule.
  - 2. Summary of Work completed during the past period between reports.
  - 3. Work planned during the next period.
  - 4. Explanation of differences between summary of Work completed and Work planned in previously submitted report.
  - 5. Current and anticipated delaying factors and estimated impact on other activities and completion milestones.
  - 6. Corrective action taken or proposed.

##### 1.3 BAR CHART SCHEDULES

- A. Format: Bar chart Schedule, to include at least:
  - 1. Identification and listing in chronological order of those activities reasonably required to complete the Work, including:
    - a. Subcontract Work.
    - b. Major equipment design, fabrication, factory testing, and delivery dates including required lead times.





- c. Move-in and other preliminary activities.
- d. Equipment and equipment system test and startup activities.
- e. Project closeout and cleanup.
- f. Work sequences, constraints, and milestones.
- 2. Listings identified by Specification Section number.
- 3. Identification of the following:
  - a. Horizontal time frame by year, month, and week.
  - b. Duration, early start, and completion for each activity and subactivity.
  - c. Critical activities and Project float.
  - d. Subschedules to further define critical portions of Work.

#### 1.4 REVIEW AND EVALUATION

- A. Participate in joint review and evaluation of schedules with Architect/Engineer at each submittal.
- B. Evaluate Project status to determine Work behind schedule and Work ahead of schedule.
- C. After review, revise schedules incorporating results of review, and resubmit within 10 days.

#### 1.5 UPDATING SCHEDULES

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity. Update schedules to depict current status of Work.
- C. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- D. Upon approval of a Change Order, include the change in the next schedule submittal.
- E. Indicate changes required to maintain Date of Substantial Completion.
- F. Submit sorts as required to support recommended changes.
- G. Prepare narrative report to define problem areas, anticipated delays, and impact on schedule. Report corrective action taken or proposed and its effect.

#### 1.6 DISTRIBUTION

- A. Following joint review, distribute copies of updated schedules to Contractor's Project site file, to Subcontractors, suppliers, Architect/Engineer, Owner, and other concerned parties.
- B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.



PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 33 00

### SUBMITTAL PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Definitions.
- B. Submittal procedures.
- C. Construction progress schedules.
- D. Proposed product list.
- E. Product data.
- F. Use of electronic CAD files of Project Drawings.
- G. Shop Drawings.
- H. Samples.
- I. Other submittals.
- J. Design data.
- K. Test reports.
- L. Certificates.
- M. Manufacturer's instructions.
- N. Manufacturer's field reports.
- O. Erection Drawings.
- P. Construction photographs.
- Q. Contractor review.
- R. Architect/Engineer review.

##### 1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect/Engineer's responsive action.



- B. Informational Submittals: Written and graphic information and physical Samples that do not require Architect/Engineer's responsive action. Submittals may be rejected for not complying with requirements.

### 1.3 SUBMITTAL PROCEDURES

- A. Transmit each submittal with AIA G810 - Transmittal Letter.
- B. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.
- C. Identify: Project, Contractor, Subcontractor and supplier, pertinent Drawing and detail number, and Specification Section number appropriate to submittal.
- D. Apply Contractor's stamp, signed or initialed, certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is according to requirements of the Work and Contract Documents.
- E. Schedule submittals to expedite Project, and deliver to Architect/Engineer at business address or submit electronic submittals via email as PDF electronic files. Coordinate submission of related items.
- F. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.
- G. Identify variations in Contract Documents and product or system limitations that may be detrimental to successful performance of completed Work.
- H. Allow space on submittals for Contractor and Architect/Engineer review stamps.
- I. When revised for resubmission, identify changes made since previous submission.
- J. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.
- K. Submittals not requested will not be recognized nor processed.
- L. Incomplete Submittals: Architect/Engineer will not review. Complete submittals for each item are required. Delays resulting from incomplete submittals are not the responsibility of Architect/Engineer.

### 1.4 CONSTRUCTION PROGRESS SCHEDULES

- A. Comply with Section 01 32 16 - Construction Progress Schedule.

### 1.5 PROPOSED PRODUCT LIST

- A. Within 15 days after date of Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.



- B. For products specified only by reference standards, indicate manufacturer, trade name, model or catalog designation, and reference standards.

## 1.6 PRODUCT DATA

- A. Product Data: Action Submittal: Submit to Architect/Engineer for review for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Submit electronic submittals via email as PDF electronic files.
- C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.7 ELECTRONIC CAD FILES OF PROJECT DRAWINGS

- A. Electronic CAD Files of Project Drawings: May only be used to expedite production of Shop Drawings for the Project. Use for other Projects or purposes is not allowed.
- B. Electronic CAD Files of Project Drawings: Distributed only under the following conditions:
  - 1. Use of files is solely at receiver's risk. Architect/Engineer does not warrant accuracy of files. Receiving files in electronic form does not relieve receiver of responsibilities for measurements, dimensions, and quantities set forth in Contract Documents. In the event of ambiguity, discrepancy, or conflict between information on electronic media and that in Contract Documents, notify Architect/Engineer of discrepancy and use information in hard-copy Drawings and Specifications.
  - 2. CAD files do not necessarily represent the latest Contract Documents, existing conditions, and as-built conditions. Receiver is responsible for determining and complying with these conditions and for incorporating addenda and modifications.
  - 3. User is responsible for removing information not normally provided on Shop Drawings and removing references to Contract Documents. Shop Drawings submitted with information associated with other trades or with references to Contract Documents will not be reviewed and will be immediately returned.
  - 4. Receiver shall not hold Architect/Engineer responsible for data or file clean-up required to make files usable, nor for error or malfunction in translation, interpretation, or use of this electronic information.
  - 5. Receiver shall understand that even though Architect/Engineer has computer virus scanning software to detect presence of computer viruses, there is no guarantee that computer viruses are not present in files or in electronic media.



6. Receiver shall not hold Architect/Engineer responsible for such viruses or their consequences, and shall hold Architect/Engineer harmless against costs, losses, or damage caused by presence of computer virus in files or media.
7. Receiver shall sign Architect/Engineer's release form to gain access to CAD files.
8. Access to or use of Architect/Engineer's CAD files is at the Architect/Engineer's sole discretion.

## 1.8 SHOP DRAWINGS

- A. Shop Drawings: Action Submittal: Submit to Architect/Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- C. When required by individual Specification Sections, provide Shop Drawings signed and sealed by a professional Engineer responsible for designing components shown on Shop Drawings.
  1. Include signed and sealed calculations to support design.
  2. Submit Shop Drawings and calculations in form suitable for submission to and approval by authorities having jurisdiction.
  3. Make revisions and provide additional information when required by authorities having jurisdiction.
- D. Submit electronic submittals via email as PDF electronic files.
- E. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 01 70 00 - Execution and Closeout Requirements.

## 1.9 SAMPLES

- A. Samples: Action Submittal: Submit to Architect/Engineer for assessing conformance with information given and design concept expressed in Contract Documents.
- B. Samples for Selection as Specified in Product Sections:
  1. Submit to Architect/Engineer for aesthetic, color, and finish selection.
  2. Submit Samples of finishes, textures, and patterns for Architect/Engineer selection.
- C. Submit Samples to illustrate functional and aesthetic characteristics of products, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.
- D. Include identification on each Sample, with full Project information.
- E. Submit number of Samples specified in individual Specification Sections; Architect/Engineer will retain one Sample.



- F. Reviewed Samples that may be used in the Work are indicated in individual Specification Sections.
- G. Samples will not be used for testing purposes unless specifically stated in Specification Section.
- H. After review, produce copies and distribute according to "Submittal Procedures" Article and for record documents described in Section 017000 - Execution and Closeout Requirements.

#### 1.10 OTHER SUBMITTALS

- A. Closeout Submittals: Comply with Section 017000 - Execution and Closeout Requirements.
- B. Informational Submittal: Submit data for Architect/Engineer's knowledge as Contract administrator or for Owner.
- C. Submit information for assessing conformance with information given and design concept expressed in Contract Documents.

#### 1.11 TEST REPORTS

- A. Informational Submittal: Submit reports for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit test reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

#### 1.12 CERTIFICATES

- A. Informational Submittal: Submit certification by manufacturer, installation/application Subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.
- B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product but must be acceptable to Architect/Engineer.

#### 1.13 MANUFACTURER'S INSTRUCTIONS

- A. Informational Submittal: Submit manufacturer's installation instructions for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to Architect/Engineer in quantities specified for Product Data.



- C. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

#### 1.14 MANUFACTURER'S FIELD REPORTS

- A. Informational Submittal: Submit reports for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit report within 5 days of observation to Architect/Engineer for information.
- C. Submit reports for information for assessing conformance with information given and design concept expressed in Contract Documents.

#### 1.15 ERECTION DRAWINGS

- A. Informational Submittal: Submit Drawings for Architect/Engineer's knowledge as Contract administrator or for Owner.
- B. Submit Drawings for information assessing conformance with information given and design concept expressed in Contract Documents.
- C. Data indicating inappropriate or unacceptable Work may be subject to action by Architect/Engineer or Owner.

#### 1.16 CONTRACTOR REVIEW

- A. Review for compliance with Contract Documents and approve submittals before transmitting to Architect/Engineer.
- B. Contractor: Responsible for:
  - 1. Determination and verification of materials including manufacturer's catalog numbers.
  - 2. Determination and verification of field measurements and field construction criteria.
  - 3. Checking and coordinating information in submittal with requirements of Work and of Contract Documents.
  - 4. Determination of accuracy and completeness of dimensions and quantities.
  - 5. Confirmation and coordination of dimensions and field conditions at Site.
  - 6. Construction means, techniques, sequences, and procedures.
  - 7. Safety precautions.
  - 8. Coordination and performance of Work of all trades.
- C. Stamp, sign or initial, and date each submittal to certify compliance with requirements of Contract Documents.
- D. Do not fabricate products or begin Work for which submittals are required until approved submittals have been received from Architect/Engineer.





#### 1.17 ARCHITECT/ENGINEER REVIEW

- A. Do not make "mass submittals" to Architect/Engineer. "Mass submittals" are defined as six or more submittals or items in one day or 15 or more submittals or items in one week. If "mass submittals" are received, Architect/Engineer's review time stated above will be extended as necessary to perform proper review. Architect/Engineer will review "mass submittals" based on priority determined by Architect/Engineer after consultation with Owner and Contractor.
- B. Informational submittals and other similar data are for Architect/Engineer's information, do not require Architect/Engineer's responsive action, and will not be reviewed or returned with comment.
- C. Submittals made by Contractor that are not required by Contract Documents may be returned without action.
- D. Submittal approval does not authorize changes to Contract requirements unless accompanied by Change Order, Architect's Supplemental Instruction or Construction Change Directive.
- E. Owner may withhold monies due to Contractor to cover additional costs beyond the second submittal review.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 35 46

### INDOOR AIR QUALITY PROCEDURES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Construction Indoor Air Quality (IAQ) Management Plan.
  - 2. HVAC air filters.
  - 3. Building flush-out.
  - 4. Indoor air quality testing.
- B. Related Sections:
  - 1. Section 23 72 00 – Air-to-Air Energy Recovery Equipment: Permanent Air Filters.

##### 1.2 REFERENCES

- A. American Society of Heating, Refrigerating & Air Conditioning Engineers (ASHRAE):
  - 1. ASHRAE 52.2 - Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.
- B. Sheet Metal and Air Conditioning National Contractors Association (SMACNA):
  - 1. SMACNA IAQ 2nd Edition 2007 - Guideline for Occupied Buildings under Construction, Chapter 3: Control Measures.
- C. U.S. Environmental Protection Agency (EPA):
  - 1. EPA IAQ Testing - Compendium of Methods for the Determination of Air Pollutants in Indoor Air.

##### 1.3 PLAN REQUIREMENTS

- A. Develop and implement Construction IAQ Management Plan according to SMACNA IAQ as approved by Architect/Engineer for compliance with the following:
- B. Intent:
  - 1. Prevent indoor air quality problems resulting from construction and renovation process.
  - 2. Protect HVAC system during construction and renovation, control pollutant sources, and interrupt contamination pathways.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit description and performance data for filters including MERV ratings.



- C. Construction IAQ Management Plan: Submit plan describing methods and procedures for implementing and monitoring compliance as specified in this Section.

## 1.5 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents:
  - 1. Certify that five design approaches of SMACNA IAQ were used during building construction and provide description of design approaches employed.

## 1.6 CONSTRUCTION IAQ MANAGEMENT PLAN

- A. Implement Construction IAQ Management Plan at start of construction.
- B. Review Construction IAQ Management Plan at preconstruction meeting and progress meetings specified in Section 01 30 00 - Administrative Requirements.
- C. Distribute approved Construction IAQ Management Plan to Subcontractors and others affected by plan requirements.
- D. Oversee plan implementation, instruct construction personnel about plan compliance, and document plan results.
- E. Address the following requirements in Construction IAQ Management Plan:
  - 1. Meeting or exceeding design approaches of SMACNA IAQ.
  - 2. Permitting adequate airing-out of new materials.
  - 3. Proper curing of concrete before covering.
  - 4. Avoiding building occupancy while construction-related pollutants are present.
  - 5. Smoking inside building.
  - 6. Dust control.
  - 7. Debris removal.

## 1.7 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Sequence material delivery and installation to avoid exposing insulation, carpeting, acoustical ceilings, gypsum board, and other absorptive materials to contamination and moisture.
  - 1. Enclose building before storing and installing moisture-sensitive products within building under construction.

## PART 2 - PRODUCTS

### 2.1 HVAC AIR FILTERS

- A. Return Filters: Filtration media rated for minimum efficiency reporting value (MERV) when tested according to ASHRAE 52.2.



1. Construction Return Filters: MERV of 8.
  2. Flush-Out Return Filters: MERV of 13.
  3. Permanent Filters: As specified in Section 23 72 00 – Air-to-Air Energy Recovery Equipment .
- B. Supply Filters: As specified in As specified in Section 23 72 00 – Air-to-Air Energy Recovery Equipment .

## PART 3 - EXECUTION

### 3.1 FILTER INSTALLATION AND REPLACEMENT

- A. Install construction return filter at each return grille before operating permanent air handlers during construction.
- B. Replace filters after completing construction and before conducting building flush-out.
1. Replace construction return filters with flush-out return filters.
  2. Replace supply filters.
- C. Replace filters after conducting building flush-out and before occupancy.
1. Replace flush-out return filters with permanent filters.
  2. Replace supply filters.

### 3.2 BUILDING FLUSH-OUT

- A. Conduct building flush-out after construction ends and before occupancy.
1. Operate HVAC air system to supply minimum of 3,500-cu ft/sq ft floor area total outdoor air volume to spaces before occupancy is permitted.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Conduct baseline indoor air quality testing procedure according to EPA IAQ Testing.
- C. Maximum Contaminant Concentrations:
1. Formaldehyde: 27 parts per billion.
  2. Particulates (PM10): 50 micrograms per cubic meter.
  3. Total Volatile Organic Compounds (TVOC): 500 micrograms per cubic meter.
  4. 4-Phenylcyclohexene (4-PCH): 6.5 micrograms per cubic meter.
  5. Carbon Monoxide (CO): 9 parts per million and no greater than 2 parts per million above outdoor levels.
- D. Conduct air sample testing according to the following:
1. Verify interior finishes, including but not limited to millwork, doors, paint, carpet and acoustic tiles, are installed. Verify movable furnishings such as workstations and partitions are installed.



2. Test air quality before occupancy, during normal occupied hours, with building ventilation system starting at normal daily start time and operated at minimum outside air flow rate for occupied mode for duration of air testing.
  3. Test air quality for each portion of building served by separate ventilation system, using minimum one sampling point for each 25,000 sq ft, or one sampling point for each contiguous floor area, whichever is larger. Include sampling points in areas with least ventilation and greatest presumed contaminant source strength as directed by Architect/Engineer.
  4. Collect air samples between 3 and 6 feet above finished floor. Collect samples over minimum 4-hour period.
- E. When tests indicate contaminants exceed maximum concentration limit, flush affected building area with outside air and retest.
1. Repeat flushing and retesting until measured contaminant concentrations are less than specified maximum limits.
  2. Take air samples for retests at same location as initial tests.

END OF SECTION



## SECTION 01 40 00

### QUALITY REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Quality control.
- B. Tolerances.
- C. References.
- D. Labeling.
- E. Mockup requirements.
- F. Testing and inspection services.
- G. Manufacturers' field services.

##### 1.2 QUALITY CONTROL

- A. Monitor quality control over suppliers, manufacturers, products, services, Site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with specified standards as the minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- C. Perform Work using persons qualified to produce required and specified quality.
- D. Products, materials, and equipment may be subject to inspection by Architect/Engineer at place of manufacture or fabrication. Such inspections shall not relieve Contractor of complying with requirements of Contract Documents.
- E. Supervise performance of Work in such manner and by such means to ensure that Work, whether completed or in progress, will not be subjected to harmful, dangerous, damaging, or otherwise deleterious exposure during construction period.

##### 1.3 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' recommended tolerances and tolerance requirements in reference standards. When such tolerances conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.



- C. Adjust products to appropriate dimensions; position before securing products in place.

#### 1.4 REFERENCES

- A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current as of date for receiving Bids except where specific date is established by code.
- C. Obtain copies of standards and maintain on Site when required by product Specification Sections.
- D. When requirements of indicated reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- E. Neither contractual relationships, duties, or responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference in reference documents.

#### 1.5 LABELING

- A. Attach label from agency approved by authorities having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.
- B. Label Information: Include manufacturer's or fabricator's identification, approved agency identification, and the following information, as applicable, on each label:
  - 1. Model number.
  - 2. Serial number.
  - 3. Performance characteristics.
- C. Manufacturer's Nameplates, Trademarks, Logos, and Other Identifying Marks on Products: Not allowed on surfaces exposed to view in public areas, interior or exterior.

#### 1.6 MOCK-UP REQUIREMENTS

- A. Tests will be performed under provisions identified in this Section and identified in individual product Specification Sections.
- B. Assemble and erect specified or indicated items with specified or indicated attachment and anchorage devices, flashings, seals, and finishes.
- C. Accepted mockups shall be comparison standard for remaining Work.
- D. Where mockup has been accepted by Architect/Engineer and is specified in product Specification Sections to be removed, remove mockup and clear area when directed to do so by Architect/Engineer.



## 1.7 TESTING AND INSPECTION SERVICES

- A. Owner will employ services of an independent firm to perform testing and inspection. Contractor shall pay for services from cash allowances specified in Section 01 20 00 - Price and Payment Procedures.
- B. Independent firm will perform tests, inspections, and other services specified in individual Specification Sections and as required by Architect/Engineer and authorities having jurisdiction.
  - 1. Laboratory: Authorized to operate in State of Maine.
  - 2. Laboratory Staff: Maintain full-time Professional Engineer or specialist on staff to review services.
  - 3. Testing Equipment: Calibrated at reasonable intervals with devices of an accuracy traceable to National Bureau of Standards or accepted values of natural physical constants.
- C. Testing, inspections, and source quality control may occur on or off Project Site. Perform off-Site testing as required by Architect/Engineer or Owner.
- D. Reports shall be submitted by independent firm to Architect/Engineer, Contractor, and authorities having jurisdiction, in duplicate, indicating observations and results of tests and compliance or noncompliance with Contract Documents.
  - 1. Submit final report indicating correction of Work previously reported as noncompliant.
- E. Cooperate with independent firm; furnish samples of materials, design mix, equipment, tools, storage, safe access, and assistance by incidental labor as requested.
  - 1. Notify Architect/Engineer and independent firm 24 hours before expected time for operations requiring services.
  - 2. Make arrangements with independent firm and pay for additional Samples and tests required for Contractor's use.
- F. Employment of testing agency or laboratory shall not relieve Contractor of obligation to perform Work according to requirements of Contract Documents.
- G. Retesting or re-inspection required because of nonconformance with specified or indicated requirements shall be performed by same independent firm on instructions from Architect/Engineer. Payment for retesting or re-inspection will be charged to Contractor by deducting testing charges from Contract Sum/Price.
- H. Agency Responsibilities:
  - 1. Test Samples of mixes submitted by Contractor.
  - 2. Provide qualified personnel at Site. Cooperate with Architect/Engineer and Contractor in performance of services.
  - 3. Perform indicated sampling and testing of products according to specified standards.
  - 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.





5. Promptly notify Architect/Engineer and Contractor of observed irregularities or nonconformance of Work or products.
  6. Perform additional tests required by Architect/Engineer.
  7. Attend preconstruction meetings and progress meetings.
- I. Agency Reports: After each test, promptly submit two copies of report to Architect/Engineer, Contractor, and authorities having jurisdiction. When requested by Architect/Engineer, provide interpretation of test results. Include the following:
1. Date issued.
  2. Project title and number.
  3. Name of inspector.
  4. Date and time of sampling or inspection.
  5. Identification of product and Specification Section.
  6. Location in Project.
  7. Type of inspection or test.
  8. Date of test.
  9. Results of tests.
  10. Conformance with Contract Documents.
- J. Limits on Testing Authority:
1. Agency or laboratory may not release, revoke, alter, or enlarge on requirements of Contract Documents.
  2. Agency or laboratory may not approve or accept any portion of the Work.
  3. Agency or laboratory may not assume duties of Contractor.
  4. Agency or laboratory has no authority to stop the Work.
- 1.8 MANUFACTURER'S FIELD SERVICES
- A. When specified in individual Specification Sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect/Engineer 30 days in advance of required observations. Observer is subject to approval of Architect/Engineer.
- C. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturer's written instructions.
- D. Refer to Section 01 33 00 - Submittal Procedures, "Manufacturer's Field Reports" Article.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 50 00

### TEMPORARY FACILITIES AND CONTROLS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Temporary Utilities:
  - 1. Temporary electricity.
  - 2. Temporary lighting for construction purposes.
  - 3. Temporary heating.
  - 4. Temporary cooling.
  - 5. Temporary ventilation.
  - 6. Communication services.
  - 7. Temporary water service.
  - 8. Temporary sanitary facilities.
- B. Construction Facilities:
  - 1. Field offices and sheds.
  - 2. Vehicular access.
  - 3. Parking.
  - 4. Progress cleaning and waste removal.
  - 5. Project identification.
  - 6. Traffic regulation.
  - 7. Fire-prevention facilities.
- C. Temporary Controls:
  - 1. Barriers.
  - 2. Enclosures and fencing.
  - 3. Security.
  - 4. Water control.
  - 5. Dust control.
  - 6. Erosion and sediment control.
  - 7. Noise control.
  - 8. Pest and rodent control.
  - 9. Pollution control.
- D. Removal of utilities, facilities, and controls.

##### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 2. ASTM E 90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.



3. ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

### 1.3 TEMPORARY ELECTRICITY

- A. Owner will pay cost of energy used. Exercise measures to conserve energy. Use Owner's existing power service.
- B. Complement existing power service capacity and characteristics as required for construction operations.
- C. Provide power outlets with branch wiring and distribution boxes located as required for construction operations. Provide suitable, flexible power cords as required for portable construction tools and equipment.
- D. Provide main service disconnect and overcurrent protection at convenient location.
- E. Permanent convenience receptacles may be used during construction.

### 1.4 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain incandescent lighting for construction operations to achieve minimum lighting level of 2 watts/sq ft .
- B. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, lamps, and the like, for specified lighting levels.
- C. Maintain lighting and provide routine repairs.
- D. Permanent building lighting may be used during construction.

### 1.5 TEMPORARY HEATING

- A. Existing heating systems may be used during construction.
- B. Owner will pay cost of temporary heat. Exercise measures to conserve energy. Use Owner's existing heat plant, extended and supplemented with temporary heat devices as needed to maintain specified conditions for construction operations.
- C. Enclose building before activating temporary heat according to "Enclosures and Fencing" Article in this Section.
- D. Before operating permanent equipment for temporary heating purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.
- E. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.



## 1.6 TEMPORARY COOLING

- A. Existing cooling systems may be used during construction.
- B. Owner will pay cost of temporary cooling. Exercise measures to conserve energy. Use Owner's existing or new cooling plant, extended and supplemented with temporary cooling devices as needed to maintain specified conditions for construction operations.
- C. Enclose building before activating temporary cooling according to "Enclosures and Fencing" Article in this Section.
- D. Before operating permanent equipment for temporary cooling purposes, verify installation is approved for operation, equipment is lubricated, and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts. Replace filters at Substantial Completion.
- E. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress unless indicated otherwise in individual product Sections.

## 1.7 TEMPORARY VENTILATION

- A. Ventilate enclosed areas to achieve curing of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Use existing ventilation equipment. Extend and supplement equipment with temporary fan units as required to maintain clean air for construction operations.

## 1.8 COMMUNICATION SERVICES

- A. Telephone Service: Provide, maintain, and pay for telephone service to field office at time of Project mobilization and until completion of Work.
- B. Internet Service: Provide, maintain, and pay for broadband Internet service to field office at time of Project mobilization. Provide desktop computer with Microsoft operating system and appropriate office function software, modem, and printer.

## 1.9 TEMPORARY WATER SERVICE

- A. Owner will pay cost of temporary water. Exercise measures to conserve energy. Use Owner's existing water system, extended and supplemented with temporary devices as needed to maintain specified conditions for construction operations.
- B. Extend branch piping with outlets located so that water is available by hoses with threaded connections. Provide temporary pipe insulation and heat tape to prevent freezing.



## 1.10 TEMPORARY SANITARY FACILITIES

- A. Designated facilities may be used during construction operations. Maintain a clean and sanitary condition daily.
- B. At end of construction, return existing facilities used for construction operations to same or better condition as original condition.

## 1.11 FIELD OFFICES AND SHEDS

- A. Field Office: Weathertight, with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with sturdy furniture including conference table, drawing rack, filing cabinets and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate six persons.
- C. Locate field offices and sheds a minimum distance of 30 feet from existing and new structures.
- D. Do not use permanent facilities for field offices or for storage.
- E. Construction: Portable or mobile buildings, or buildings constructed with floors raised aboveground, securely fixed to foundations with steps and landings at entrance doors.
  - 1. Construction: Structurally sound, secure, weathertight enclosures for office and storage spaces. Maintain during progress of Work; remove enclosures when no longer needed.
  - 2. Thermal Resistance of Floors, Walls, and Ceilings: Compatible with occupancy and storage requirements.
  - 3. Exterior Materials: Weather-resistant, finished in one color acceptable to Architect/Engineer.
  - 4. Interior Materials in Field Offices: Sheet-type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
  - 5. Lighting for Field Offices: 50 ft-C at desktop height; exterior lighting at entrance doors.
  - 6. Interior Materials in Storage Sheds: As required to provide specified conditions for storage of products.
- F. Environmental Control:
  - 1. Heating, Cooling, and Ventilating for Offices: Automatic equipment to maintain comfort conditions.
  - 2. Storage Spaces: Heating and ventilating as needed to maintain products according to Contract Documents; lighting for maintenance and inspection of products.
- G. Storage Areas and Sheds: Size to storage requirements for products of individual Sections, allowing for access and orderly provision for maintenance and inspection of products to suit requirements in Section 016000 - Product Requirements.
- H. Preparation: Fill and grade Sites for temporary structures sloped for drainage away from buildings.



- I. Installation:
  - 1. Install field office spaces ready for occupancy 15 days after date established by Notice to Proceed.
  - 2. Employee Residential Occupancy: Not allowed on Owner's property.
- J. Maintenance and Cleaning:
  - 1. Weekly janitorial services for field offices; periodic cleaning and maintenance for sheds and storage areas.
  - 2. Maintain walks free of mud, water, snow, and the like.
- K. Removal: At completion of Work remove buildings, foundations, utility services, and debris. Restore areas to same or better condition as original condition.

#### 1.12 VEHICULAR ACCESS

- A. Construct temporary all-weather access roads from public thoroughfares to serve construction area, of width and load-bearing capacity to accommodate unimpeded traffic for construction purposes.
- B. Construct temporary bridges and culverts to span low areas and allow unimpeded drainage.
- C. Extend and relocate vehicular access as Work progress requires and provide detours as necessary for unimpeded traffic flow.
- D. Locate as approved by Architect/Engineer.
- E. Provide unimpeded access for emergency vehicles. Maintain 20 foot-wide driveways with turning space between and around combustible materials.
- F. Provide and maintain access to fire hydrants and control valves free of obstructions.
- G. Provide means of removing mud from vehicle wheels before entering streets.
- H. Use designated existing on-Site roads for construction traffic.

#### 1.13 PARKING

- A. Arrange for temporary paved surface parking areas to accommodate construction personnel.
- B. Locate as approved by Architect/Engineer.
- C. If Site space is not adequate, provide additional off-Site parking.
- D. Use of designated areas of existing on-Site streets and driveways used for construction traffic is permitted. Tracked vehicles are not allowed on paved areas.



- E. Use of designated areas of existing parking facilities used by construction personnel is permitted.
- F. Do not allow heavy vehicles or construction equipment in parking areas.
- G. Do not allow vehicle parking on existing pavement.
- H. Permanent Pavements and Parking Facilities:
  - 1. Before Substantial Completion, bases for permanent roads and parking areas may be used for construction traffic.
  - 2. Avoid traffic loading beyond paving design capacity. Tracked vehicles are not allowed.
  - 3. Use of permanent parking structures is not permitted.
- I. Maintenance:
  - 1. Maintain traffic and parking areas in sound condition free of excavated material, construction equipment, products, mud, snow, ice, and the like.
  - 2. Maintain existing and permanent paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original condition.
- J. Removal, Repair:
  - 1. Remove temporary materials and construction at Substantial Completion.
  - 2. Remove underground Work and compacted materials to depth of 2 feet; fill and grade Site as indicated.
  - 3. Repair existing and permanent facilities damaged by use, to original condition.
- K. Mud from Site vehicles: Provide means of removing mud from vehicle wheels before entering streets.

#### 1.14 PROGRESS CLEANING AND WASTE REMOVAL

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain Site in clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, before enclosing spaces.
- C. Broom and vacuum clean interior areas before starting surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and rubbish from Site periodically and dispose of off-Site.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.



## 1.15 PROJECT IDENTIFICATION

- A. Project Identification Sign:
  - 1. One painted sign, 32 sq ft area, bottom 6 feet aboveground.
  - 2. Content:
    - a. Project title, logo, and name of Owner.
    - b. Names and titles of authorities.
    - c. Names and titles of Architect/Engineer and Consultants.
    - d. Name of Prime Contractor.
  - 3. Graphic Design, Colors, and Style of Lettering: Designated by Architect/Engineer.
- B. Project Informational Signs:
  - 1. Painted informational signs of same colors and lettering as Project identification sign or standard products; size lettering for legibility at 100-foot distance.
  - 2. Provide sign at each field office and storage shed, and provide directional signs to direct traffic into and within Site. Relocate as Work progress requires.
  - 3. Provide state traffic agency directional traffic signs to and within Site.
  - 4. No other signs are allowed without Owner's permission except those required by law.
- C. Design sign and structure to withstand 60-mph wind velocity.
- D. Sign Painter: Experienced as professional sign painter for minimum of three years.
- E. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.
- F. Show content, layout, lettering, color, foundation, structure, sizes, and grades of members.
- G. Sign Materials:
  - 1. Structure and Framing: New wood, structurally adequate.
  - 2. Sign Surfaces: Exterior grade plywood with medium-density overlay, minimum of 3/4 inches thick, standard large sizes to minimize joints.
  - 3. Rough Hardware: Galvanized.
  - 4. Paint and Primers: Exterior quality, two coats; sign background of color as selected.
  - 5. Lettering: Exterior quality paint, contrasting colors as selected.
- H. Installation:
  - 1. Install Project identification sign within 15 days after date established by Notice to Proceed.
  - 2. Erect at location of high public visibility adjacent to main entrance to Site.
  - 3. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
  - 4. Install sign surface plumb and level, with butt joints. Anchor securely.
  - 5. Paint exposed surfaces of sign, supports, and framing.





- I. Maintenance: Maintain clean signs and supports; repair deterioration and damage.
- J. Removal: Remove signs, framing, supports, and foundations at completion of Project and restore area.

#### 1.16 TRAFFIC REGULATION

- A. Signs, Signals, and Devices:
  - 1. Post-Mounted and Wall-Mounted Traffic Control and Informational Signs: As approved by authorities having jurisdiction.
  - 2. Traffic Control Signals: As approved by local jurisdictions.
  - 3. Traffic Cones, Drums, Flares, and Lights: As approved by authorities having jurisdiction.
  - 4. Flag Person Equipment: As required by authorities having jurisdiction.
- B. Flag Persons: Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.
- C. Flares and Lights: Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.
- D. Haul Routes:
  - 1. Consult with authorities having jurisdiction and establish public thoroughfares to be used for haul routes and Site access.
  - 2. Confine construction traffic to designated haul routes.
  - 3. Provide traffic control at critical areas of haul routes to regulate traffic and to minimize interference with public traffic.
- E. Traffic Signs and Signals:
  - 1. Provide signs at approaches to Site and on Site, at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
  - 2. Provide, operate, and maintain traffic control signals to direct and maintain orderly flow of traffic in areas under Contractor's control and areas affected by Contractor's operations.
  - 3. Relocate signs and signals as Work progresses, to maintain effective traffic control.
- F. Removal:
  - 1. Remove equipment and devices at Substantial Completion.
  - 2. Repair damage caused by installation.
  - 3. Remove post settings to depth of 2 feet.

#### 1.17 FIRE-PREVENTION FACILITIES

- A. Prohibit smoking within buildings under construction and demolition. Designate area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.



- B. Establish fire watch for cutting, welding, and other hazardous operations capable of starting fires. Maintain fire watch before, during, and after hazardous operations until threat of fire does not exist.
- C. Portable Fire Extinguishers: NFPA 10; 10-pound capacity, 4A-60B: C UL rating.
  - 1. Provide one fire extinguisher at each stairway on each floor of buildings under construction and demolition.
  - 2. Provide minimum of one fire extinguisher in every construction trailer and storage shed.
  - 3. Provide minimum of one fire extinguisher on roof during roofing operations using heat-producing equipment.

#### 1.18 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas , to allow for Owner's use of Site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by authorities having jurisdiction for public rights-of-way and for public access to existing building.
- C. Tree and Plant Protection: Preserve and protect existing trees and plants designated to remain.
  - 1. Protect areas within drip lines from traffic, parking, storage, dumping, chemically injurious materials and liquids, ponding, and continuous running water.
  - 2. Provide 6 -foot-high barriers around drip line, with access for maintenance.
  - 3. Replace trees and plants damaged by construction operations.
- D. Protect non-owned vehicular traffic, stored materials, Site, and structures from damage.

#### 1.19 ENCLOSURES AND FENCING

- A. Construction: Contractor's option.
- B. Provide 6-foot-high fence around construction Site; equip with vehicular and pedestrian gates with locks.
- C. Exterior Enclosures:
  - 1. Provide temporary insulated weathertight closure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual Specification Sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.
- D. Interior Enclosures:
  - 1. Provide temporary partitions as indicated on Drawings to separate work areas from Owner-occupied areas, to prevent penetration of dust and moisture into Owner-occupied areas, and to prevent damage to existing materials and equipment.



2. Construction: Framing and gypsum board sheet materials with closed joints and sealed edges at intersections with existing surfaces.
  - a. STC rating of 35 according to ASTM E 90.
  - b. Surface-Burning Characteristics: Maximum 200/450 flame-spread/smoke-developed index when tested according to ASTM E 84.
  - c. Fire-Rated Wall Construction: 1-hour rating.
    - 1) Tested Rating: Determined according to ASTM E 119.
3. Paint surfaces exposed to view from Owner-occupied areas.

## 1.20 SECURITY

- A. Security Program:
  1. Protect Work on existing premises and Owner's operations from theft, vandalism, and unauthorized entry.
  2. Initiate program in coordination with Owner's existing security system at Project mobilization.
  3. Maintain program throughout construction period until directed by Architect/Engineer.
- B. Entry Control:
  1. Restrict entrance of persons and vehicles to Project Site and existing facilities.
  2. Allow entrance only to authorized persons with proper identification.
  3. Maintain log of workers and visitors and make available to Owner on request.
  4. Coordinate access of Owner's personnel to Site in coordination with Owner's security forces.
- C. Personnel Identification:
  1. Provide identification badge for each person authorized to enter premises.
  2. employer.
  3. Maintain list of accredited persons and submit copy to Owner on request.
  4. Require return of badges at expiration of employment on the Work.
- D. Restrictions:
  1. Do not allow cameras on Site or photographs taken except by written approval of Owner.

## 1.21 WATER CONTROL

- A. Grade Site to drain. Maintain excavations free of water. Provide, operate, and maintain necessary pumping equipment.
- B. Protect Site from puddles or running water. Provide water barriers as required to protect Site from soil erosion.

## 1.22 DUST CONTROL

- A. Execute Work by methods that minimize raising dust from construction operations.



- B. Provide positive means to prevent airborne dust from dispersing into atmosphere and into Owner-occupied areas.

#### 1.23 EROSION AND SEDIMENT CONTROL

- A. Plan and execute construction by methods to control surface drainage from cuts and fills from borrow and waste disposal areas. Prevent erosion and sedimentation.
- B. Minimize surface area of bare soil exposed at one time.
- C. Provide temporary measures including berms, dikes, drains, and other devices to prevent water flow.
- D. Construct fill and waste areas by selective placement to avoid erosive surface silts and clays.
- E. Periodically inspect earthwork to detect evidence of erosion and sedimentation. Promptly apply corrective measures.

#### 1.24 NOISE CONTROL

- A. Provide methods, means, and facilities to minimize noise produced by construction operations.

#### 1.25 PEST AND RODENT CONTROL

- A. Provide methods, means, and facilities to prevent pests and insects from entering facility.
- B. Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

#### 1.26 POLLUTION CONTROL

- A. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious, toxic substances and pollutants produced by construction operations.
- B. Comply with pollution and environmental control requirements of authorities having jurisdiction.

#### 1.27 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Remove temporary utilities, equipment, facilities, and materials before Substantial Completion inspection.
- B. Remove underground installations to minimum depth of 2 feet. Grade Site as indicated on Drawings.



- C. Clean and repair damage caused by installation or use of temporary Work.
- D. Restore existing and permanent facilities used during construction to original condition.  
Restore permanent facilities used during construction to specified condition.

PART 2 - PRODUCTS - Not Used

PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 60 00

### PRODUCT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Products.
- B. Product delivery requirements.
- C. Product storage and handling requirements.
- D. Product options.
- E. Equipment electrical characteristics and components.

##### 1.2 PRODUCTS

- A. At minimum, comply with specified requirements and reference standards.
- B. Specified products define standard of quality, type, function, dimension, appearance, and performance required.
- C. Furnish products of qualified manufacturers that are suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise. Confirm that manufacturer's production capacity can provide sufficient product, on time, to meet Project requirements.
- D. Do not use materials and equipment removed from existing premises except as specifically permitted by Contract Documents.
- E. Furnish interchangeable components from same manufacturer for components being replaced.

##### 1.3 PRODUCT DELIVERY REQUIREMENTS

- A. Transport and handle products according to manufacturer's instructions.
- B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.
- C. Provide equipment and personnel to handle products; use methods to prevent soiling, disfigurement, or damage.

##### 1.4 PRODUCT STORAGE AND HANDLING REQUIREMENTS

- A. Store and protect products according to manufacturer's instructions.
- B. Store products with seals and labels intact and legible.



- C. Store sensitive products in weathertight, climate-controlled enclosures in an environment suitable to product.
- D. For exterior storage of fabricated products, place products on sloped supports aboveground.
- E. Provide bonded off-Site storage and protection when Site does not permit on-Site storage or protection.
- F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- G. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.
- H. Provide equipment and personnel to store products; use methods to prevent soiling, disfigurement, or damage.
- I. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

#### 1.5 PRODUCT OPTIONS

- A. Products Specified by Reference Standards or by Description Only: Products complying with specified reference standards or description.
- B. Products Specified by Naming One or More Manufacturers: Products of one of manufacturers named and complying with Specifications; no options or substitutions allowed.
- C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit Request for Substitution for any manufacturer not named, according to Section 01 25 00 - Substitution Procedures.

### PART 2 - PRODUCTS

#### 2.1 EQUIPMENT ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Include lugs for terminal box.
- B. Cord and Plug: Furnish minimum 6-foot long cord and plug including grounding connector for connection to electric wiring system. Cord of longer length may be specified in individual Specification Sections.

### PART 3 - EXECUTION - Not Used

END OF SECTION



## SECTION 01 70 00

### EXECUTION AND CLOSEOUT REQUIREMENTS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Field engineering.
- B. Closeout procedures.
- C. Starting of systems.
- D. Demonstration and instructions.
- E. Testing, adjusting, and balancing.
- F. Project record documents.
- G. Operation and maintenance data.
- H. Manual for materials and finishes.
- I. Manual for equipment and systems.
- J. Spare parts and maintenance products.
- K. Product warranties and product bonds.
- L. Maintenance service.
- M. Examination.
- N. Preparation.
- O. Execution.
- P. Cutting and patching.
- Q. Protecting installed construction.
- R. Final cleaning.

##### 1.2 FIELD ENGINEERING

- A. Employ land surveyor registered in State of Maine and acceptable to Architect/Engineer.
- B. Locate and protect survey control and reference points. Promptly notify Architect/Engineer of discrepancies discovered.





- C. Control datum for survey is established by Owner-provided survey.
- D. Prior to beginning Work, verify and establish floor elevations of existing facilities to ensure that new Work will meet existing elevations in smooth and level alignment except where specifically detailed or indicated otherwise.
- E. Verify setbacks and easements; confirm Drawing dimensions and elevations.
- F. Provide field engineering services. Establish elevations, lines, and levels using recognized engineering survey practices.
- G. Submit copy of Site drawing and certificate signed by land surveyor certifying elevations and locations of the Work are in conformance with Contract Documents.
- H. Maintain complete and accurate log of control and survey Work as Work progresses.
- I. Protect survey control points prior to starting Site Work; preserve permanent reference points during construction.
- J. Promptly report to Architect/Engineer loss or destruction of reference point or relocation required because of changes in grades or other reasons.
- K. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect/Engineer.

### 1.3 CLOSEOUT PROCEDURES

- A. Prerequisites to Substantial Completion: Complete following items before requesting Certification of Substantial Completion, either for entire Work or for portions of Work:
  - 1. Submit maintenance manuals, Project record documents, and other similar final record data in compliance with this Section.
  - 2. Complete facility startup, testing, adjusting, balancing of systems and equipment, demonstrations, and instructions to Owner's operating and maintenance personnel as specified in compliance with this Section.
  - 3. Conduct inspection to establish basis for request that Work is substantially complete. Create comprehensive list (initial punch list) indicating items to be completed or corrected, value of incomplete or nonconforming Work, reason for being incomplete, and date of anticipated completion for each item. Include copy of list with request for Certificate of Substantial Completion.
  - 4. Obtain and submit releases enabling Owner's full, unrestricted use of Project and access to services and utilities. Include certificate of occupancy, operating certificates, and similar releases from authorities having jurisdiction and utility companies.
  - 5. Deliver tools, spare parts, extra stocks of material, and similar physical items to Owner.
  - 6. Make final change-over of locks eliminating construction master-key system and transmit keys directly to Owner. Advise Owner's personnel of change-over in security provisions.



7. Discontinue or change over and remove temporary facilities and services from Project Site, along with construction tools, mockups, and similar elements.
8. Perform final cleaning according to this Section.

**B. Substantial Completion Inspection:**

1. When Contractor considers Work to be substantially complete, submit to Architect/Engineer:
  - a. Written certificate that Work, or designated portion, is substantially complete.
  - b. List of items to be completed or corrected (initial punch list).
2. Within seven days after receipt of request for Substantial Completion, Architect/Engineer will make inspection to determine whether Work or designated portion is substantially complete.
3. Should Architect/Engineer determine that Work is not substantially complete:
  - a. Architect/Engineer will promptly notify Contractor in writing, stating reasons for its opinion.
  - b. Contractor shall remedy deficiencies in Work and send second written request for Substantial Completion to Architect/Engineer.
  - c. Architect/Engineer will reinspect Work.
  - d. Redo and Inspection of Deficient Work: Repeated until Work passes Architect/Engineer's inspection.
4. When Architect/Engineer finds that Work is substantially complete, Architect/Engineer will:
  - a. Prepare Certificate of Substantial Completion on AIA G704 - Certificate of Substantial Completion, accompanied by Contractor's list of items to be completed or corrected as verified and amended by Architect/Engineer and Owner (final punch list).
  - b. Submit Certificate to Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.
5. After Work is substantially complete, Contractor shall:
  - a. Allow Owner occupancy of Project under provisions stated in Certificate of Substantial Completion.
  - b. Complete Work listed for completion or correction within time period stipulated.
6. Owner will occupy all of building as specified in Section 01 10 00 - Summary.

**C. Prerequisites for Final Completion: Complete following items before requesting final acceptance and final payment.**

1. When Contractor considers Work to be complete, submit written certification that:
  - a. Contract Documents have been reviewed.
  - b. Work has been examined for compliance with Contract Documents.
  - c. Work has been completed according to Contract Documents.
  - d. Work is completed and ready for final inspection.
2. Submittals: Submit following:
  - a. Final punch list indicating all items have been completed or corrected.



- b. Final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
  - c. Specified warranties, workmanship/maintenance bonds, maintenance agreements, and other similar documents.
  - d. Accounting statement for final changes to Contract Sum.
  - e. Contractor's affidavit of payment of debts and claims on AIA G706 - Contractor's Affidavit of Payment of Debts and Claims.
  - f. Contractor affidavit of release of liens on AIA G706A - Contractor's Affidavit of Release of Liens.
  - g. Consent of surety to final payment on AIA G707 - Consent of Surety to Final Payment Form.
3. Perform final cleaning for Contractor-soiled areas according to this Section.

D. Final Completion Inspection:

- 1. Within seven days after receipt of request for final inspection, Architect/Engineer Owner will make inspection to determine whether Work or designated portion is complete.
- 2. Should Architect/Engineer consider Work to be incomplete or defective:
  - a. Architect/Engineer will promptly notify Contractor in writing, listing incomplete or defective Work.
  - b. Contractor shall remedy stated deficiencies and send second written request to Architect/Engineer that Work is complete.
  - c. Architect/Engineer will reinspect Work.
  - d. Redo and Inspection of Deficient Work: Repeated until Work passes Architect/Engineer's inspection.

#### 1.4 STARTING OF SYSTEMS

- A. Coordinate schedule for startup of various equipment and systems.
- B. Notify Architect/Engineer seven days prior to startup of each item.
- C. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- D. Verify that tests, meter readings, and electrical characteristics agree with those required by equipment or system manufacturer.
- E. Verify that wiring and support components for equipment are complete and tested.
- F. Execute startup under supervision of manufacturer's representative or Contractors' personnel according to manufacturer's instructions.
- G. When specified in individual Specification Sections, require manufacturer to provide authorized representative who will be present at Site to inspect, check, and approve equipment or system installation prior to startup and will supervise placing equipment or system in operation.



- H. Submit a written report according to Section 01 33 00 - Submittal Procedures that equipment or system has been properly installed and is functioning correctly.

#### 1.5 DEMONSTRATION AND INSTRUCTIONS

- A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.
- B. Demonstrate Project equipment and instruct in classroom environment located at project site and instructed by authorized manufacturer's representative who is knowledgeable about the Project.
- C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Use operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.
- E. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.
- F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.
- G. Required instruction time for each item of equipment and system is specified in individual Specification Sections.

#### 1.6 TESTING, ADJUSTING, AND BALANCING

- A. Owner will appoint and employ services of independent firm to perform testing, adjusting, and balancing. Contractor shall pay for services from cash allowance specified in Section 01 20 00 - Price and Payment Procedures.
- B. Independent firm will perform services specified in Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.
- C. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or noncompliance with requirements of Contract Documents.

#### 1.7 PROJECT RECORD DOCUMENTS

- A. Maintain on Site one set of the following record documents; record actual revisions to the Work:
  - 1. Drawings.
  - 2. Specifications.
  - 3. Addenda.



4. Change Orders and other modifications to the Contract.
  5. Reviewed Shop Drawings, product data, and Samples.
  6. Manufacturer's instruction for assembly, installation, and adjusting.
- B. Ensure entries are complete and accurate, enabling future reference by Owner.
- C. Store record documents separate from documents used for construction.
- D. Record information concurrent with construction progress, not less than weekly.
- E. Specifications: Legibly mark and record, at each product Section, description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
  2. Product substitutions or alternates used.
  3. Changes made by Addenda and modifications.
- F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction as follows:
1. Include Contract modifications such as Addenda, supplementary instructions, change directives, field orders, minor changes in the Work, and change orders.
  2. Include locations of concealed elements of the Work.
  3. Identify depth of buried utility lines and provide dimensions showing distances from permanent facility components that are parallel to utilities.
  4. Dimension ends, corners, and junctions of buried utilities to permanent facility components using triangulation.
  5. Identify and locate existing buried or concealed items encountered during Project.
  6. Measured depths of foundations in relation to finish main floor datum.
  7. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  8. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
  9. Field changes of dimension and detail.
  10. Details not on original Drawings.
- G. Submit PDF electronic files of marked-up documents to Architect/Engineer before Substantial Completion.

## 1.8 OPERATION AND MAINTENANCE DATA

- A. Submit in PDF composite electronic indexed file.
- B. Submit data bound in 8-1/2 x 11-inch text pages, three D side ring binders with durable plastic covers.
- C. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS," title of Project, and subject matter of binder when multiple binders are required.



- D. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- E. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- F. Contents: Prepare table of contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
  - 1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
  - 2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by Specification Section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Include the following:
    - a. Significant design criteria.
    - b. List of equipment.
    - c. Parts list for each component.
    - d. Operating instructions.
    - e. Maintenance instructions for equipment and systems.
    - f. Maintenance instructions for special finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
    - g. Safety precautions to be taken when operating and maintaining or working near equipment.
  - 3. Part 3: Project documents and certificates, including the following:
    - a. Shop Drawings and product data.
    - b. Air and water balance reports.
    - c. Certificates.
    - d. Originals or Photocopies of warranties and bonds.

#### 1.9 MANUAL FOR MATERIALS AND FINISHES

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes before Substantial Completion. Draft copy to be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes within ten days after final inspection.
- E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.



- F. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designations. Include information for re-ordering custom-manufactured products.
- G. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- H. Moisture Protection and Weather Exposed Products: Include product data listing applicable reference standards, chemical composition, and details of installation. Include recommendations for inspections, maintenance, and repair.
- I. Additional Requirements: As specified in individual product Specification Sections.
- J. Include listing in table of contents for design data, with tabbed fly sheet and space for insertion of data.

#### 1.10 MANUAL FOR EQUIPMENT AND SYSTEMS

- A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.
- B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.
- C. Submit one copy of completed volumes before Substantial Completion. Draft copy will be reviewed and returned after final inspection, with Architect/Engineer comments. Revise content of document sets as required prior to final submission.
- D. Submit two sets of revised final volumes within ten days after final inspection.
- E. Submit in PDF composite electronic indexed file of final manual within ten days after final inspection.
- F. Each Item of Equipment and Each System: Include description of unit or system and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.
- G. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; typed by label machine.
- H. Include color-coded wiring diagrams as installed.
- I. Operating Procedures: Include startup, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and special operating instructions.



- J. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- K. Include servicing and lubrication schedule and list of lubricants required.
- L. Include manufacturer's printed operation and maintenance instructions.
- M. Include sequence of operation by controls manufacturer.
- N. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- O. Include control diagrams by controls manufacturer as installed.
- P. Include Contractor's coordination drawings with color-coded piping diagrams as installed.
- Q. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- R. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- S. Include test and balancing reports as specified in Section 01 40 00 - Quality Requirements.
- T. Additional Requirements: As specified in individual product Specification Sections.
- U. Include listing in table of contents for design data with tabbed dividers and space for insertion of data.

#### 1.11 SPARE PARTS AND MAINTENANCE PRODUCTS

- A. Furnish spare parts, maintenance, and extra products in quantities specified in individual Specification Sections.
- B. Deliver to Project Site and place in location as directed by Owner; obtain receipt prior to final payment.

#### 1.12 PRODUCT WARRANTIES AND PRODUCT BONDS

- A. Obtain warranties and bonds executed in duplicate by responsible Subcontractors, suppliers, and manufacturers within ten days after completion of applicable item of Work.
- B. Execute and assemble transferable warranty documents and bonds from Subcontractors, suppliers, and manufacturers.
- C. Verify documents are in proper form, contain full information, and are notarized.





- D. Co-execute submittals when required.
- E. Include table of contents and assemble in three D side ring binder with durable plastic cover.
- F. Submit prior to final Application for Payment.
- G. Time of Submittals:
  - 1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within ten days after acceptance.
  - 2. Make other submittals within ten days after date of Substantial Completion, prior to final Application for Payment.
  - 3. For items of Work for which acceptance is delayed beyond Substantial Completion, submit within ten days after acceptance, listing date of acceptance as beginning of warranty or bond period.

## PART 2 - PRODUCTS - Not Used

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new Work being applied or attached.
- C. Examine and verify specific conditions described in individual Specification Sections.
- D. Verify that utility services are available with correct characteristics and in correct locations.

### 3.2 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance according to manufacturer's instructions.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer-required or -recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

### 3.3 EXECUTION

- A. Comply with manufacturer's installation instructions, performing each step in sequence. Maintain one set of manufacturer's installation instructions at Project Site during installation and until completion of construction.



- B. When manufacturer's installation instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- C. Verify that field measurements are as indicated on approved Shop Drawings or as instructed by manufacturer.
- D. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.
  - 1. Secure Work true to line and level and within specified tolerances, or if not specified, industry-recognized tolerances.
  - 2. Physically separate products in place, provide electrical insulation, or provide protective coatings to prevent galvanic action or corrosion between dissimilar metals.
  - 3. Exposed Joints: Provide uniform joint width and arrange to obtain best visual effect. Refer questionable visual-effect choices to Architect/Engineer for final decision.
- E. Allow for expansion of materials and building movement.
- F. Climatic Conditions and Project Status: Install each unit of Work under conditions to ensure best possible results in coordination with entire Project.
  - 1. Isolate each unit of Work from incompatible Work as necessary to prevent deterioration.
  - 2. Coordinate enclosure of Work with required inspections and tests to minimize necessity of uncovering Work for those purposes.
- G. Mounting Heights: Where not indicated, mount individual units of Work at industry recognized standard mounting heights for particular application indicated.
  - 1. Refer questionable mounting heights choices to Architect/Engineer for final decision.
  - 2. Elements Identified as Accessible to Handicapped: Comply with applicable codes and regulations.
- H. Adjust operating products and equipment to ensure smooth and unhindered operation.
- I. Clean and perform maintenance on installed Work as frequently as necessary through remainder of construction period. Lubricate operable components as recommended by manufacturer.

### 3.4 CUTTING AND PATCHING

- A. Employ skilled and experienced installers to perform cutting and patching.
- B. Submit written request in advance of cutting or altering elements affecting:
  - 1. Structural integrity of element.
  - 2. Integrity of weather-exposed or moisture-resistant elements.
  - 3. Efficiency, maintenance, or safety of element.
  - 4. Visual qualities of sight-exposed elements.
  - 5. Work of Owner or separate contractor.



- C. Execute cutting, fitting, and patching including excavation and fill to complete Work and to:
  - 1. Fit the several parts together, to integrate with other Work.
  - 2. Uncover Work to install or correct ill-timed Work.
  - 3. Remove and replace defective and nonconforming Work.
  - 4. Remove samples of installed Work for testing.
  - 5. Provide openings in elements of Work for penetrations of mechanical and electrical Work.
- D. Execute Work by methods to avoid damage to other Work and to provide proper surfaces to receive patching and finishing.
- E. Cut masonry and concrete materials using masonry saw or core drill.
- F. Restore Work with new products according to requirements of Contract Documents.
- G. Fit Work tight to pipes, sleeves, ducts, conduits, and other penetrations through surfaces.
- H. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- I. At penetrations of fire-rated walls, partitions, ceiling, or floor construction, completely seal voids with fire-rated material according to Section 07 84 00 - Firestopping, to full thickness of penetrated element.
- J. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for assembly, refinish entire unit.
- K. Identify hazardous substances or conditions exposed during the Work to Architect/Engineer for decision or remedy.

### 3.5 PROTECTING INSTALLED CONSTRUCTION

- A. Protect installed Work and provide special protection where specified in individual Specification Sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate Work area to prevent damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Use durable sheet materials to protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. When traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic from landscaped areas.



### 3.6 FINAL CLEANING

- A. Execute final cleaning prior to final Project assessment.
  - 1. Employ experienced personnel or professional cleaning firm.
- B. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains, and foreign substances; polish transparent and glossy surfaces; and vacuum carpeted and soft surfaces.
- C. Clean equipment and fixtures to sanitary condition with appropriate cleaning materials.
- D. Replace filters of operating equipment.
- E. Clean debris from roofs, gutters, downspouts, and drainage systems.
- F. Clean Site; sweep paved areas, rake clean landscaped surfaces.
- G. Remove waste and surplus materials, rubbish, and construction facilities from Site.

END OF SECTION



## SECTION 02 41 19.13

### SELECTIVE BUILDING DEMOLITION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Demolishing designated building equipment and fixtures.
  - 2. Demolishing designated construction.
  - 3. Cutting and alterations for completion of the Work.
  - 4. Removing designated items for reuse and Owner's retention.
  - 5. Protecting items designated to remain.
  - 6. Removing demolished materials.

##### 1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Demolition Schedule: Indicate overall schedule and interruptions required for utility and building services.
- C. Shop Drawings:
  - 1. Indicate demolition and removal sequence.
  - 2. Indicate location of items designated for reuse and Owner's retention.
  - 3. Indicate location and construction of temporary work.

##### 1.3 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Accurately record actual locations of capped utilities, concealed utilities discovered during demolition, and subsurface obstructions.
- C. Operation and Maintenance Data: Submit description of system, inspection data, and parts lists.

##### 1.4 QUALITY ASSURANCE

- A. Conform to applicable code for demolition work, dust control, products requiring electrical disconnection and re-connection.
- B. Conform to applicable code for procedures when hazardous or contaminated materials are discovered.
- C. Obtain required permits from authorities having jurisdiction.

##### 1.5 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.



## 1.6 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Owner will conduct salvage operations before demolition begins to remove materials Owner chooses to retain.

## 1.7 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements and 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- B. Schedule Work to coincide with new construction.
- C. Cooperate with Owner in scheduling noisy operations and waste removal that may impact Owners operation in adjoining spaces.
- D. Coordinate utility and building service interruptions with Owner.
  - 1. Do not disable or disrupt building fire or life safety systems without three days prior written notice to Owner.
  - 2. Schedule tie-ins to existing systems to minimize disruption.
  - 3. Coordinate Work to ensure fire sprinklers, fire alarms, smoke detectors, emergency lighting, exit signs and other life safety systems remain in full operation in occupied areas.

## 1.8 PROJECT CONDITIONS

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Cease operations immediately if structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

## PART 2 - PRODUCTS

- 2.1 Not Used.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Notify affected utility companies before starting work and comply with their requirements.
- B. Mark location and termination of utilities.
- C. Erect, and maintain temporary barriers and security devices at appropriate locations, including warning signs and lights, and similar measures, for protection of the public, Owner, and existing improvements indicated to remain.
- D. Erect and maintain weatherproof closures for exterior openings.
- E. Erect and maintain temporary partitions to prevent spread of dust, odors, and noise to permit continued Owner occupancy.



- F. Prevent movement of structure; provide temporary bracing and shoring required to ensure safety of existing structure.
- G. Provide appropriate temporary signage including signage for exit or building egress.
- H. Do not close or obstruct building egress path.
- I. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

### 3.2 SALVAGE REQUIREMENTS

- A. Coordinate with Owner to identify building components and equipment required to be removed and delivered to Owner.
- B. Tag components and equipment Owner designates for salvage.
- C. Protect designated salvage items from demolition operations until items can be removed.
- D. Carefully remove building components and equipment indicated to be salvaged.
- E. Disassemble as required to permit removal from building.
- F. Package small and loose parts to avoid loss.
- G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.
- H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.
- I. Deliver salvaged items to Owner. Obtain signed receipt from Owner.

### 3.3 DEMOLITION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Maintain protected egress from and access to adjacent existing buildings at all times.
- C. Do not close or obstruct roadways or sidewalks without permits.
- D. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer.
- E. Disconnect and remove designated utilities within demolition areas.
- F. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate Record Drawings indicating location and type of service for capped utilities remaining after demolition.



- G. Demolish in orderly and careful manner. Protect existing improvements and supporting structural members.
- H. Carefully remove building components indicated to be reused.
  - 1. Disassemble components as required to permit removal.
  - 2. Package small and loose parts to avoid loss.
  - 3. Mark components and packaged parts to permit reinstallation.
  - 4. Store components, protected from construction operations, until reinstalled.
- I. Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- J. Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- K. Remove temporary Work.

END OF SECTION





## SECTION 02 82 13.33

### ASBESTOS ABATEMENT FOR UTILITIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Removal of ACM-contaminated pipeline coatings.
  - 2. Cutting of pipelines containing or coated with ACM.
  - 3. Monitoring of Work area during cutting and cleaning operations.

##### 1.2 DEFINITIONS

- A. ACM: Asbestos-containing material.

##### 1.3 REFERENCE STANDARDS

- A. Occupational Safety and Health Administration (OSHA):
  - 1. 29 CFR Part 1926 - Safety and Health Regulations for Construction.
  - 2. 40 CFR Part 763, Subpart E, Appendix E, Section 1- Polarized Light Microscopy.
  - 3. 42 CFR Part 84, Subpart K - Non-Powered Air-Purifying Particulate Respirators.
- B. U.S. Environmental Protection Agency:
  - 1. National Emission Standards for Hazardous Air Pollutants (NESHAPs).

##### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

##### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on respirators and air monitor.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
  - 1. Submit qualifications for contractor, on-Site representative, and disposal firm.
  - 2. Submit qualifications for testing laboratory.



## 1.6 QUALITY ASSURANCE

- A. Perform Work according to NESHAPs and OSHA standards.

## 1.7 QUALIFICATIONS

- A. Contractor: Company specializing in repairing, modifying, cleaning, or removing AC pipe or ACM-coated pipe as specified in this Section with minimum three years' experience.
- B. On-Site Representative: Person trained in performing Work of this Section with minimum three years' experience.
- C. Disposal Firm: Company specializing in packaging and hauling ACM to disposal site.
- D. Active Waste Disposal Site: Solid waste disposal site permitted to accept ACM waste.
- E. Testing Laboratory: Company participating in National Voluntary Laboratory Accreditation Program for asbestos, administered by National Institutes of Standards and Technology.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Respirators Not in Use:
  - 1. Store in sanitary location that protects respirators from dust, sunlight, heat, extreme cold, excessive moisture, and potentially damaging chemicals.
  - 2. Place in plastic bags or closed containers.

## PART 2 - PRODUCTS

### 2.1 RESPIRATORS

- A. Description:
  - 1. Comply with 42 CFR Part 84, Subpart K.
  - 2. Type: Half-face mask; reusable after washing.
  - 3. Maintenance: Replaceable filters and cartridges only.
  - 4. Single-use respirators are not acceptable.
- B. Filters: Top air inlet.



- C. Performance and Design Criteria:
  - 1. Application: Asbestos abatement for concentrations up to 10 times permissible exposure limit (PEL).
  - 2. Design: Low profile.

## 2.2 AIR MONITOR

- A. Description:
  - 1. Type: Laser.
  - 2. Power Source: Batteries.
  - 3. Screen: LCD.
  - 4. Output: Greater than 0.5 micron and 2.5 micron particulates.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Perform ACM removal without damage to or contamination of adjacent Work or existing area.
- C. Perform cleaning operations without taking pipeline out of service.

### 3.2 APPLICATION

- A. Removal of Pipe Coating:
  - 1. Use cleaning machines or "line-traveling machines" that move along pipeline while removing exterior pipe coating.
  - 2. Collect coating residue in bags and dispose in a permitted active waste disposal site.

### 3.3 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Sample Testing:
  - 1. Test pipe or pipe coating for asbestos prior to repairing, modifying, or removing pipelines.
  - 2. Remove samples of pipe or coating along entire length of piping to be removed and have testing laboratory determine quantity of asbestos that may be present.

END OF SECTION



## SECTION 03 10 00

### CONCRETE FORMING AND ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Formwork for cast-in-place concrete.
2. Shoring, bracing, and anchorage.
3. Architectural form liners.
4. Form accessories.
5. Form stripping.

###### B. Related Requirements:

1. Section 03 20 00 - Concrete Reinforcing: Reinforcing steel and required supports for cast-in-place concrete.
2. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frame, slabs-on-grade, and other concrete components associated with building.
3. Section 04 20 00 - Unit Masonry:
  - a. Positioning of recessed reglets for brick veneer masonry anchors.
  - b. Product requirements for masonry accessories for placement by this Section.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

###### A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.

###### B. Formwork (Vertical Structures):

1. Basis of Measurement: By square foot.
2. Basis of Payment: Includes form materials, placement, placing accessories, and stripping.

###### C. Formwork (Horizontal Supported Structures):

1. Basis of Measurement: By square foot.
2. Basis of Payment: Includes form materials, placement, placing accessories, and stripping.

##### 1.3 REFERENCE STANDARDS

###### A. American Concrete Institute:

1. ACI 117 - Specification for Tolerances for Concrete Construction and Materials.
2. ACI 301 - Specifications for Structural Concrete.
3. ACI 318 - Building Code Requirements for Structural Concrete.
4. ACI 347 - Guide to Formwork for Concrete.



- B. American Forest & Paper Association:
  - 1. AF&PA - National Design Specification (NDS) for Wood Construction.
- C. American Society of Mechanical Engineers:
  - 1. ASME A17.1 - Safety Code for Elevators and Escalators.
- D. APA - The Engineered Wood Association:
  - 1. APA/EWA PS 1 - Voluntary Product Standard - Structural Plywood.
- E. ASTM International:
  - 1. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
  - 2. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- F. West Coast Lumber Inspection Bureau:
  - 1. WCLIB - Standard No. 17 Grading Rules for West Coast Lumber.

#### 1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other Sections of Work in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other Work.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on void form materials and installation requirements.
- C. Shop Drawings:
  - 1. Indicate:
    - a. Formwork, shoring, and reshoring.
    - b. Pertinent dimensions, openings, methods of construction, types of connections, materials, joint arrangement and details, ties and shores, location of framing, studding and bracing, and temporary supports.
    - c. Means of leakage prevention for concrete exposed to view in finished construction.
    - d. Sequence and timing of erection and stripping, assumed compressive strength at time of stripping, height of lift, and height of drop during placement.
    - e. Vertical, horizontal, and special loads according to ACI 347, and camber diagrams when applicable.
    - f. Notes to formwork erector showing size and location of conduits and piping embedded in concrete according to ACI 318.



- g. Procedure and schedule for removal of shores and installation and removal of reshores.
  - D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  - E. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
  - F. Qualifications Statement:
    - 1. Submit qualifications for licensed professional.
- 1.6 SUSTAINABLE DESIGN SUBMITTALS
- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
  - B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements.
    - 1. Materials Resources Certificates:
      - a. Certify recycled material content for recycled content products.
      - b. Certify source for regional materials and distance from Project Site.
      - c. Certify that lumber is harvested from FSC-Certified well-managed forest.
  - C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
    - 1. Provide cost data for following products:
      - a. Products with recycled material content.
      - b. Regional products.
      - c. Certified wood products.
- 1.7 QUALITY ASSURANCE
- A. Perform Work in accordance with ACI 301, 318, and 347 standards.
  - B. For wood products furnished for Work of this Section, comply with AF&PA.
  - C. Maintain copy of each standard affecting Work of this Section on Site.
- 1.8 DELIVERY, STORAGE, AND HANDLING
- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
  - B. Inspection: Accept void forms on Site in manufacturer's original packaging and inspect for damage.
  - C. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.



## PART 2 - PRODUCTS

### 2.1 WOOD FORM MATERIALS

- A. Form Materials: At discretion of Contractor.

### 2.2 FORMWORK ACCESSORIES

- A. Form Ties: Type typical with Contractor's forming system.
- B. Spreaders:
  - 1. Description: Standard, non-corrosive metal-form clamp assembly, of type acting as spreaders and leaving no metal within 1 inch of concrete face.
  - 2. Wire ties, wood spreaders, or through bolts are not permitted.
- C. Form Release Agent:
  - 1. Description: Colorless mineral oil that will not stain concrete or absorb moisture.
- D. Corners: Chamfered, wood strip type; 3/4-inch by 3/4-inch size; maximum possible lengths.
- E. Vapor Retarder:
  - 1. Description: Polyethylene sheet.
  - 2. Thickness: 8 mils.
- F. Bituminous Joint Filler: Comply with ASTM D1751.
- G. Nails, Spikes, Lag Bolts, Through Bolts, Anchorages: Size, strength, and character to maintain formwork in place while placing concrete.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify lines, levels, and centers before proceeding with formwork.
- C. Verify that dimensions agree with Drawings.
- D. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, request instructions from Architect/Engineer before proceeding.

### 3.2 INSTALLATION

- A. Earth Forms: Not permitted.
- B. Formwork:



1. Provide top form for sloped surfaces steeper than 1.5 horizontal to 1 vertical to hold shape of concrete during placement, unless it can be demonstrated that top forms can be omitted.
2. Construct forms to correct shape and dimensions, mortar-tight, braced, and of sufficient strength to maintain shape and position under imposed loads from construction operations.
3. Camber forms where necessary to produce level finished soffits unless indicated otherwise on Drawings.
4. Positioning:
  - a. Carefully verify horizontal and vertical positions of forms.
  - b. Correct misaligned or misplaced forms before placing concrete.
5. Complete wedging and bracing before placing concrete.
6. Erect formwork, shoring, and bracing to achieve design requirements according to ACI 301 and 318.
7. Stripping:
  - a. Arrange and assemble formwork to permit dismantling and stripping.
  - b. Do not damage concrete during stripping.
  - c. Permit removal of remaining principal shores.
8. Obtain approval of Architect/Engineer before framing openings in structural members not indicated on Drawings.
9. Install void forms according to manufacturer instructions.
10. Do not patch formwork.
11. Leave forms in place for minimum number of days according to ACI 347.

C. Form Removal:

1. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads, and removal has been approved by Architect/Engineer.
2. Loosen forms carefully; do not wedge pry bars, hammers, or tools against finish concrete surfaces scheduled for exposure to view.
3. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged.
4. Discard damaged forms.
5. Form Release Agent:
  - a. Apply according to manufacturer instructions.
  - b. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.
  - c. Soak inside surfaces of untreated forms with clean water, and keep surfaces coated prior to placement of concrete.
6. Form Cleaning:
  - a. Clean forms as erection proceeds to remove foreign matter within forms.
  - b. Clean formed cavities of debris prior to placing concrete.
  - c. Flush with water or use compressed air to remove remaining foreign matter.
  - d. Ensure that water and debris drain to exterior through cleanout ports.





- e. Cold Weather:
  - 1) During cold weather, remove ice and snow from within forms.
  - 2) Do not use de-icing salts.
  - 3) Do not use water to clean out forms unless formwork and concrete construction proceed within heated enclosure; use compressed air or other dry method to remove foreign matter.
- 7. Reuse and Coating of Forms:
  - a. Thoroughly clean forms and reapply form coating before each reuse.
  - b. For exposed Work, do not reuse forms with damaged faces or edges.
  - c. Apply form coating to forms according to manufacturer instructions.
  - d. Do not coat forms for concrete indicated to receive "scored finish."
  - e. Apply form coatings before placing reinforcing steel.
- D. Forms for Smooth Finish Concrete:
  - 1. Use steel, plywood, or lined-board forms.
  - 2. Use clean and smooth plywood and form liners, uniform in size, and free from surface and edge damage capable of affecting resulting concrete finish.
  - 3. Install form lining with close-fitting square joints between separate sheets without springing into place.
  - 4. Use full-sized sheets of form liners and plywood wherever possible.
  - 5. Tape joints to prevent protrusions in concrete.
  - 6. Apply forming and strip wood forms in a manner to protect corners and edges.
  - 7. Level and continue horizontal joints.
  - 8. Keep wood forms wet until stripped.
- E. Forms for Surfaces to Receive Membrane Waterproofing:
  - 1. Use plywood or steel forms.
  - 2. After erection of forms, tape form joints to prevent protrusions in concrete.
- F. Framing, Studding, and Bracing:
  - 1. Maximum Spacing of Studs:
    - a. Boards: Maximum 16 inches o.c.
    - b. Plywood: 12 inches o.c.
  - 2. Size framing, bracing, centering, and supporting members for sufficient strength to maintain shape and position under imposed loads from construction operations.
  - 3. Construct beam soffits of material minimum 2 inches.
  - 4. Distribute bracing loads over base area on which bracing is erected.
  - 5. When placed on ground, protect against undermining, settlement, and accidental impact.
- G. Form Anchors and Hangers:
  - 1. Do not use anchors and hangers leaving exposed metal at concrete surface.
  - 2. Symmetrically arrange hangers supporting forms from structural-steel members to minimize twisting or rotation of member.
  - 3. Penetration of structural-steel members is not permitted.



- H. Inserts, Embedded Parts, and Openings:
  - 1. Install formed openings for items to be embedded in or passing through concrete Work.
  - 2. Locate and set in place items required to be cast directly into concrete.
  - 3. Position recessed reglets for brick veneer masonry anchors according to spacing and intervals as specified in Section 04 20 00 - Unit Masonry
  - 4. Install accessories straight, level, and plumb, and ensure that items are not disturbed during concrete placement.
  - 5. Joints:
    - a. Install waterstops continuous without displacing reinforcement.
  - 6. Openings:
    - a. Provide temporary ports or openings in formwork as required to facilitate cleaning and inspection.
    - b. Locate openings at bottom of forms to allow flushing water to drain.
  - 7. Close temporary openings with tight-fitting panels, flush with inside face of forms, and neatly fitted such that joints will not be apparent in exposed concrete surfaces.
- I. Form Ties:
  - 1. Provide sufficient strength and quantity to prevent spreading of forms.
  - 2. Place ties at least 1 inch away from finished surface of concrete.
  - 3. Leave inner rods in concrete when forms are stripped.
  - 4. Space form ties equidistant, symmetrical, and aligned vertically and horizontally unless indicated otherwise on Drawings.
- J. Arrange formwork to allow proper erection sequence and to permit form removal without damage to concrete.
- K. Construction Joints:
  - 1. Install surfaced pouring strip where construction joints intersect on exposed surfaces to provide straight line at joints.
  - 2. Just prior to subsequent concrete placement, remove strip and tighten forms to conceal shrinkage.
  - 3. Appearance:
    - a. Show no overlapping of construction joints.
    - b. Construct joints to present same appearance as butted plywood joints.
  - 4. Arrange joints in continuous line straight, true, and sharp.
- L. Embedded Items:
  - 1. Make provisions for pipes, sleeves, anchors, inserts, reglets, anchor slots, nailers, waterstops, and other features.
  - 2. Do not embed wood or uncoated aluminum in concrete.
  - 3. Obtain installation and setting information for embedded items furnished under other Sections.



4. Securely anchor embedded items in correct location and alignment prior to placing concrete.
5. Ensure that conduits and pipes, including those made of coated aluminum, meet requirements of ACI 318 regarding size and location limitations.

M. Openings for Items Passing through Concrete:

1. Frame openings in concrete where indicated on Drawings.
2. Establish exact locations, sizes, and other conditions required for openings and attachment of Work specified under other Sections.
3. Coordinate Work to avoid cutting and patching of concrete after placement.
4. Perform cutting and repairing of concrete required as result of failure to provide required openings.

N. Screeds:

1. Set screeds and establish levels for tops of and finish on concrete slabs.
2. Slope slabs to drain where required or as indicated on Drawings.
3. Before depositing concrete, remove debris from space to be occupied by concrete and thoroughly wet forms; remove freestanding water.

O. Screed Supports:

1. For concrete over waterproof membranes and vapor retarder membranes, use cradle-, pad-, or base-type screed supports that will not puncture membrane.
2. Staking through membrane is not permitted.

P. Cleanouts and Access Panels:

1. Provide removable cleanout sections or access panels at bottoms of forms to permit inspection and effective cleaning of loose dirt, debris, and waste material.
2. Clean forms and surfaces against which concrete is to be placed.
3. Remove chips, sawdust, and other debris.
4. Thoroughly blow out forms with compressed air just before concrete is placed.

### 3.3 TOLERANCES

- A. Construct formwork to maintain tolerances according to ACI 301 and 318.

### 3.4 ATTACHMENTS

- A. Basement Walls Not Exposed to View: Site-fabricated plywood coated with form oil.
- B. Basement Walls Exposed to View: Site-fabricated rough-sawn lumber.
- C. Supported Floor Slabs: Prefabricated glass-fiber pan forms, treated for exposed-to-view finish.

END OF SECTION



## SECTION 03 20 00

### CONCRETE REINFORCING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Reinforcing bars.
2. Welded wire fabric.
3. Reinforcement accessories.

###### B. Related Requirements:

1. Section 03 10 00 - Concrete Forming and Accessories: Form materials, waterstops, and accessories required to form cast-in-place concrete.
2. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frame, slabs on grade, and other concrete components associated with building.
3. Section 03 35 00 - Concrete Finishing: Reinforcement for concrete floor toppings.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

###### A. Bar Reinforcement:

1. Basis of Measurement: By ton.
2. Basis of Payment: Includes reinforcement, placement, and accessories.

###### B. Welded Wire Fabric Reinforcement:

1. Basis of Measurement: By square foot.
2. Basis of Payment: Includes welded wire reinforcement, placement, and accessories.

##### 1.3 REFERENCE STANDARDS

###### A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 318 - Building Code Requirements for Structural Concrete.
3. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
4. ACI SP-66 - ACI Detailing Manual.

###### B. American Welding Society:

1. AWS D1.4 - Structural Welding Code - Reinforcing Steel.

###### C. ASTM International:

1. ASTM A184 - Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement.



2. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
3. ASTM A704 - Standard Specification for Welded Steel Plain Bar or Rod Mats for Concrete Reinforcement.
4. ASTM A706 - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement.
5. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement.

D. Concrete Reinforcing Steel Institute:

1. CRSI 10-MSP - Manual of Standard Practice.
2. CRSI 10PLACE - Placing Reinforcing Bars.

#### 1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with placement of formwork, formed openings, and other Work.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings:
1. Indicate bar sizes, spacings, locations, splice locations, and quantities of reinforcing steel and welded wire fabric.
  2. Indicate bending and cutting schedules.
  3. Indicate supporting and spacing devices.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Submit certified copies of mill test report of reinforcement materials analysis.
- E. Welder Certificates: Certify welders and welding procedures employed on Work, verifying AWS qualification within previous 12 months.
- F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statement:
1. Welders: Qualify procedures and personnel according to AWS D1.1.

#### 1.6 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.



- B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements.
  - 1. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  - 1. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work according ACI 301 and ACI 318.
- B. Prepare Shop Drawings according to ACI SP-66.
- C. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.8 QUALIFICATIONS

- A. Welders: AWS qualified within previous 12 months for employed weld types.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

#### 1.10 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.



## PART 2 - PRODUCTS

### 2.1 REINFORCEMENT

- A. Reinforcing Steel:
  - 1. Comply with ASTM A615.
  - 2. Yield Strength: 60 ksi.
  - 3. Billet Bars: Deformed.
  - 4. Finish: Uncoated.

### 2.2 FABRICATION

- A. Fabricate concrete reinforcement according to ACI 318.
- B. Form standard hooks for 90-degree bends and stirrups and tie hooks and as indicated on Drawings.
- C. Form reinforcement bends with minimum diameters according to ACI 318.
- D. Fabricate column reinforcement with offset bends at reinforcement splices.
- E. Form ties and stirrups from following:
  - 1. Bars No. 10 and Smaller: No. 4 deformed bars.
  - 2. Bars No. 11 and Larger: No. 4 deformed bars.
- F. Weld reinforcement according to AWS D1.4.
- G. Splicing:
  - 1. If not indicated on Drawings, locate reinforcement splices at point of minimum stress.

### 2.3 ACCESSORY MATERIALS

- A. Tie Wire:
  - 1. Minimum 16 gage, annealed type.
- B. Chairs, Bolsters, Bar Supports, and Spacers:
  - 1. Size and Shape: To strengthen and support reinforcement during concrete placement conditions.
- C. Special Chairs, Bolsters, Bar Supports, and Spacers Adjacent to Weather-Exposed Concrete Surfaces:
  - 1. Size and Shape: To meet Project conditions.

### 2.4 SOURCE QUALITY CONTROL

- A. Provide shop inspection and testing of completed assembly.



- B. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- C. Owner Inspection:
  - 1. Make completed concrete reinforcing available for inspection at manufacturer's factory prior to packaging for shipment.
  - 2. Notify Owner at least seven.
- D. Owner Witnessing:
  - 1. Allow witnessing of factory inspections and test at manufacturer's test facility.
  - 2. Notify Owner at least seven days before inspections and tests are scheduled.
- E. Certificate of Compliance:
  - 1. If fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved fabricator.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Place, support, and secure reinforcement against displacement.
- B. Do not deviate from required position beyond specified tolerance.
- C. Do not weld crossing reinforcement bars for assembly.
- D. vapor retarder.
- E. Accommodate placement of formed openings.
- F. Spacing:
  - 1. Space reinforcement bars with minimum clear spacing according to ACI 318.
  - 2. If bars are indicated in multiple layers, place upper bars directly above lower bars.
- G. Maintain minimum concrete cover around reinforcement according to ACI 318.
  - 1. Footings and Concrete Formed against Earth: 3 inches.
  - 2. Concrete Exposed to Earth or Weather:
    - a. No. 6 Bars and Larger: 2 inches.
    - b. No. 5 Bars and Smaller: 1-1/2 inches.
  - 3. Supported Slabs, Walls, and Joists:
    - a. No. 14 Bars and Larger: 1-1/2 inches.
    - b. No. 11 Bars and Smaller: 3/4 inch.
  - 4. Beams and Columns: 1-1/2 inches.
  - 5. Shell and Folded Plate Members:
    - a. No. 6 Bars and Larger: 3/4 inch.
    - b. No. 5 Bars and Smaller: 1/2 inch.





### 3.2 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Install reinforcement within following tolerances for flexural members, walls, and compression members:
  - 1. Reinforcement Depth Greater Than 8 Inches:
    - a. Depth Tolerance: Plus or Minus 3/8 inch.
    - b. Concrete Cover Tolerance: Minus 3/8 inch.
  - 2. Reinforcement Depth Less Than or Equal to 8 Inches:
    - a. Depth Tolerance: Plus or Minus 1/2 inch.
    - b. Concrete Cover Tolerance: Minus 1/2 inch.
- C. Foundation Walls: Install reinforcement within tolerances according to ACI 530/530.1.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Perform field inspection testing according to ACI 318.
- C. Provide unrestricted access to Work and cooperate with appointed testing firm.
- D. Reinforcement Inspection:
  - 1. Placement Acceptance: Inspect specified and ACI 318 material requirements and specified placement tolerances.
  - 2. Welding: Inspect welds according to AWS D1.1.
  - 3. Periodic Placement Inspection: Inspect for correct materials, fabrication, sizes, locations, spacing, concrete cover, and splicing.
  - 4. Weldability Inspection: Inspect for reinforcement weldability if formed from steel other than ASTM A706 (A706M).
  - 5. Continuous Weld Inspection: Inspect reinforcement according to ACI 318.
  - 6. Periodic Weld Inspection: Inspect other welded connections.

### 3.4 ATTACHMENTS

- A. Reinforcement for Superstructure Framing Members: Deformed bars, unfinished.
- B. Reinforcement for Foundation Wall Framing Members and Slabs on Grade: Deformed bars and wire fabric, galvanized finish.
- C. Reinforcement for Parking Structure Framing Members: Deformed bars, epoxy-coated finish.

END OF SECTION



## SECTION 03 30 00

### CAST-IN-PLACE CONCRETE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes Cast-in-Place Concrete for Following Items:

1. Retaining walls.
2. Foundation walls.
3. Footings.
4. Slabs on grade.
5. Control, expansion, and contraction joint devices.
6. Equipment pads.

B. Related Requirements:

1. Section 03 10 00 - Concrete Forming and Accessories
2. Section 03 20 00 - Concrete Reinforcing: Requirements for reinforcing steel and supports.
3. Section 03 35 00 - Concrete Finishing: Finishing of concrete floor surfaces.
4. Section 03 39 00 - Concrete Curing: Curing of concrete floor surfaces.
5. Section 07 90 00 - Joint Protection: Requirements for sealants and primers.
6. Section 07 95 00 - Expansion Control: Requirements for expansion and control joint cover assemblies.
7. Section 31 23 23 - Fill: Sand layer over vapor retarder.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.

B. Concrete - Slab-on-Fill or Grade:

1. Basis of Measurement:
  - a. By square foot.
  - b. By cubic yard.
2. Basis of Payment: Includes concrete, placement accessories, consolidating, leveling, troweling, and curing.

C. Concrete - Vertical in Forms:

1. Basis of Measurement:
  - a. By square foot.
  - b. By cubic yard.
2. Basis of Payment: Includes concrete, placement accessories, consolidating, and curing.



D. Concrete - Miscellaneous Locations:

1. Basis of Measurement:
  - a. By square foot.
  - b. By cubic yard.
2. Basis of Payment: Includes concrete, placement accessories, consolidating, leveling, troweling, and curing.

E. Concrete - Grouting:

1. Basis of Measurement: By cubic yard.
2. Basis of Payment: Includes preparation of substrate, grout, placement, consolidating, troweling, and curing.

F. Devices – Control:

1. Basis of Measurement: By linear foot.
2. Basis of Payment: Includes component, placement, and accessories.

### 1.3 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 301 - Specifications for Structural Concrete.
2. ACI 305R - Guide to Hot Weather Concreting.
3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 308.1 - Specification for Curing Concrete.
5. ACI 318 - Building Code Requirements for Structural Concrete.

B. ASTM International:

1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
2. ASTM C33 - Standard Specification for Concrete Aggregates.
3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
6. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
7. ASTM C150 - Standard Specification for Portland Cement.
8. ASTM C172 - Standard Practice for Sampling Freshly Mixed Concrete.
9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
12. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
13. ASTM C595 - Standard Specification for Blended Hydraulic Cements.



14. ASTM C685 - Standard Specification for Concrete Made by Volumetric Batching and Continuous Mixing.
15. ASTM C1017 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
16. ASTM C1064 - Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete.
17. ASTM C1218 - Standard Test Method for Water-Soluble Chloride in Mortar and Concrete.
18. ASTM C1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures.
19. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
20. ASTM D1752 - Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
21. ASTM D6690 - Standard Specification for Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements.
22. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
24. ASTM E1643 - Standard Practice for Selection, Design, Installation, and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs.
25. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs.

C. California Department of Health Care Services:

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (includes Addendum 2004).

D. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

#### 1.4 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of joint devices with erection of concrete formwork and placement of form accessories.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.



- B. Product Data: Submit data on joint devices, attachment accessories and admixtures.
- C. Design Data:
  - 1. Submit concrete mix design for each concrete strength.
  - 2. Submit separate mix designs if admixtures are required for following:
    - a. Hot and cold weather concrete Work.
    - b. Air entrained concrete Work.
  - 3. Identify mix ingredients and proportions, including admixtures.
  - 4. Identify chloride content of admixtures and whether or not chlorides were added during manufacture.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer Instructions: Submit installation procedures and interfacing required with adjacent Work.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of embedded utilities and components concealed from view in finished construction.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work according to ACI 301 and 318.
- B. Comply with ACI 305R when pouring concrete during hot weather.
- C. Comply with ACI 306.1 when pouring concrete during cold weather.
- D. Acquire cement and aggregate from one source for Work.
- E. Maintain copy of each standard affecting Work of this Section on Site.

### PART 2 - PRODUCTS

#### 2.1 MATERIALS

- A. Concrete:
  - 1. Cement:
    - a. Comply with ASTM C150 Type IIA - Air Entraining
    - b. Type: Portland.
  - 2. Normal Weight Aggregates:
    - a. Comply with ASTM C33.
    - b. Coarse Aggregate Maximum Size: 1 ½ inches.



- 3. Water:
  - a. Comply with ACI 318.
  - b. Potable.
- B. Admixtures:
  - 1. Air Entrainment: Comply with ASTM C260.
  - 2. Chemical:
    - a. Comply with ASTM C494.
    - b. Type A - Water Reducing.

## 2.2 CONCRETE MIX

- A. Select proportions for normal weight concrete according to ACI 301.
- B. Performance and Design Criteria:
  - 1. Compressive Strength: 4000 psi.
  - 2. Cement Type: ASTM C150.
  - 3. Minimum Cement Content: 611lb./cu. yd.
  - 4. Aggregate Type: Normal weight.
  - 5. Maximum Water-Cement Ratio: 0.44 by weight.
  - 6. Aggregate Size:
    - a. Maximum: 1 ½”.
  - 7. Air Content: 6 percent, plus or minus 1.5 percent.
  - 8. Slump: 4inches plus or minus 1 inch (25 mm).
- C. Admixtures:
  - 1. Include admixture types and quantities indicated in concrete mix designs only if approved by Architect/Engineer.
  - 2. Cold Weather:
    - a. Use accelerating admixtures in cold weather.
    - b. Use of admixtures will not relax cold-weather placement requirements.
  - 3. Hot Weather: Use set-retarding admixtures.
- D. Ready-Mixed Concrete: Mix and deliver concrete according to ASTM C94.
- E. Site-Mixed Concrete: Mix concrete according to ACI 318.

## 2.3 ACCESSORIES

- A. Vapor Retarder:
  - 1. Description: Clear polyethylene film.
  - 2. Thickness: 10 mils.
  - 3. Type: As recommended for below-grade application.
  - 4. Joint Tape: As recommended by manufacturer.
- B. Non-shrink Grout:



1. Description: Premixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing agents.
2. Comply with ASTM.
3. Minimum Compressive Strength: 2,400 psi in 48 hours and 7,000 psi in 28 days.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify requirements for concrete cover over reinforcement.
- C. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with placing concrete.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Previously Placed Concrete:
  1. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent.
  2. Remove laitance, coatings, and unsound materials.
- C. In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels, and pack solid with non-shrink grout.
- D. Remove debris and ice from formwork, reinforcement, and concrete substrates.
- E. Remove water from areas receiving concrete before concrete is placed.

### 3.3 INSTALLATION

- A. Placing Concrete:
  1. Place concrete according to ACI 301 and 318
  2. Notify testing laboratory minimum 24 hours prior to commencement of operations.
  3. Ensure that reinforcement, inserts, embedded parts, formed expansion and contraction joints are not disturbed during concrete placement.
  4. Install vapor retarder under interior slabs on grade according to ASTM E1643.
  5. Lap joints minimum 6 inches and seal watertight by taping edges and ends.
  6. Repairs:
    - a. Repair vapor retarder damaged during placement of concrete reinforcement.
    - b. Using vapor retarder material, lap over damaged areas minimum 6 inches and seal watertight.



7. Joint Filler:
  - a. Separate slabs on grade from vertical surfaces with ½ thick joint filler.
  - b. Place joint filler in floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
  - c. Finish Joint Sealer Requirements: As specified in Section 07 90 00 - Joint Protection
8. Joint Devices:
  - a. Coordination: Install construction joint devices in coordination with floor slab pattern placement sequence; set top to required elevations; secure to resist movement by wet concrete.
  - b. Install joint covers in longest practical length when adjacent construction activity is complete.
  - c. Apply sealants in joint devices as specified in Section 07 90 00 - Joint Protection
9. Deposit concrete at final position, preventing segregation of mix.
10. Place concrete in continuous operation for each panel or section as determined by predetermined joints.
11. Consolidate concrete.
12. Maintain records of concrete placement, including date, location, quantity, air temperature, and test samples taken.
13. Place concrete continuously between predetermined expansion, control, and construction joints.
14. Do not interrupt successive placement and do not permit cold joints to occur.
15. Saw-Cut Joints:
  - a. Saw-cut joints within 12 hours after placing.
  - b. Use 3/16 inch thick blade.
  - c. Cut into 1/4 depth of slab thickness.
16. Screeding:
  - a. Screed slabs on grade level.
  - b. Surface Flatness: FF 20 maximum 1/4 inch in 10 feet.

B. Separate Floor Toppings:

1. Prior to placing floor topping, remove deleterious material, roughen substrate concrete surface, and broom and vacuum clean.

C. Concrete Finishing:

1. Finish concrete floor surfaces as specified in Section 03 35 00 - Concrete Finishing.

D. Curing and Protection:

1. Cure concrete floor surfaces as specified in Section 03 39 00 - Concrete Curing.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.





- B. Provide unrestricted access to Work and cooperate with appointed testing and inspection firm.
- C. Submit proposed mix design to testing firm for review prior to commencement of Work.
- D. Concrete Inspections:
  - 1. Continuous Placement Inspection: Inspect for proper installation procedures.
  - 2. Periodic Curing Inspection: Inspect for specified curing temperature and procedures.
- E. Strength Test Samples:
  - 1. Sampling Procedures: Comply with ASTM C172.
  - 2. Cylinder Molding and Curing Procedures:
    - a. Comply with ASTM C31.
    - b. Cylinder Specimens: Standard cured.
  - 3. Sample concrete and make one set of three cylinders for every 75 cu. yd. or less of each class of concrete placed each day, and for every 5,000 sq. ft. of surface area for slabs and walls.
  - 4. If volume of concrete for a class of concrete would provide less than five sets of cylinders, take samples from five randomly selected batches, or from every batch if less than five batches are used.
  - 5. Make one additional cylinder during cold weather concreting and field cure.
- F. Field Testing:
  - 1. Slump Test Method: Comply with ASTM C143.
  - 2. Air Content Test Method: Comply with ASTM C173.
  - 3. Temperature Test Method: Comply with ASTM C1064.
  - 4. Compressive Strength Concrete:
    - a. Measure slump and temperature for each sample.
    - b. Measure air content in air-entrained concrete for each sample.
- G. Cylinder Compressive Strength Testing:
  - 1. Test Method: Comply with ASTM C39.
  - 2. Test Acceptance: According to ACI 318.
  - 3. Test one cylinder at seven days.
  - 4. Test three cylinders at 28 days.
- H. Water-Soluble Chloride Ion Concentration Test Method:
  - 1. Comply with ASTM C1218.
  - 2. Test at 28 days.
  - 3. Maximum Chloride Ion Concentration: As permitted by applicable code.
- I. Patching:
  - 1. Allow Architect/Engineer to inspect concrete surfaces immediately upon removal of forms.



2. Honeycombing or Embedded Debris in Concrete:
    - a. Not acceptable.
    - b. Notify Architect/Engineer upon discovery.
  3. Patch imperfections according to ACI 301 and 318.
- J. Defective Concrete:
1. Description: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.
  2. Repair or replacement of defective concrete will be determined by Architect/Engineer.
  3. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.

END OF SECTION



## SECTION 03 35 00

### CONCRETE FINISHING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Finishing concrete floors
  - 2. Floor surface treatment.
- B. Related Requirements:
  - 1. Section 03 30 00 - Cast-in-Place Concrete: Prepared concrete floors ready to receive finish; control and formed expansion and contraction joints and joint devices.
  - 2. Section 03 35 23 - Exposed Aggregate Concrete Finishing: Exposed aggregate finish.
  - 3. Section 03 39 00 - Concrete Curing: Procedures for curing horizontal and vertical concrete surfaces.
  - 4. Section 07 90 00 - Joint Protection: Sealants, sealers, and gaskets for sealing joints.
  - 5. Section 07 95 00 - Expansion Control: Floor, wall, and ceiling expansion or control joint cover assemblies.

##### 1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete for Buildings.
  - 2. ACI 302.1 - Guide to Concrete Floor and Slab Construction.
- B. ASTM International:
  - 1. ASTM E1155 - Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers.
  - 2. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with concrete floor placement and concrete floor curing.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.



- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- D. Manufacturer's Certificate:
  - 1. Certify that products meet or exceed specified sustainable design requirements.
  - 2. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
  - 3. Indoor Air Quality Certificates: Certify VOC content for each flooring system.
- E. Product Cost Data:
  - 1. Submit cost of products to verify compliance with Project sustainable design requirements.
  - 2. Exclude cost of labor and equipment to install products.
  - 3. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Operation and Maintenance Data: Submit information on maintenance renewal of applied coatings.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 301 and 302.1.
- B. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.



- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Do not finish floors until interior heating system is operational.

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that floor surfaces are acceptable to receive Work of this Section.

### 2.2 APPLICATION

- A. Concrete Floor Finishing:
  - 1. Comply with ACI 301.
  - 2. Steel-trowel surfaces receiving carpeting and to be exposed.
- B. Floor Surface Treatment:
  - 1. Apply liquid hardener on floor surfaces.

### 2.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Measure for FF and FL tolerances for floors according to ASTM E1155 (E1155M), within 48 hours after slab installation.

### 2.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.



- B. Acceptance:
1. Correct defects in defined traffic floor by grinding or removal and replacement of defective Work.
  2. Remeasure corrected areas by procedure as specified in TOLERANCES Article.

END OF SECTION



SECTION 03 39 00  
CONCRETE CURING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes: Initial and final curing of horizontal and vertical concrete surfaces.
- B. Related Requirements:
  - 1. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components associated with construction.
  - 2. Section 03 35 00 - Concrete Finishing: Surface finishing of concrete floor slabs and toppings.

1.2 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete.
  - 2. ACI 302.1 - Guide to Concrete Floor and Slab Construction.
  - 3. ACI 308.1 - Specification for Curing Concrete.
  - 4. ACI 318 - Building Code Requirements for Structural Concrete and Commentary.
- B. ASTM International:
  - 1. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
  - 2. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
  - 3. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete.
  - 4. ASTM D2103 - Standard Specification for Polyethylene Film and Sheeting.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's information on curing compounds, mats, paper, and film, including compatibilities and limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.



## 1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate:
  - 1. Certify that products meet or exceed specified sustainable design requirements.
  - 2. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data:
  - 1. Submit cost of products to verify compliance with Project sustainable design requirements.
  - 2. Exclude cost of labor and equipment to install products.
  - 3. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

## 1.5 QUALITY ASSURANCE

- A. Perform Work according to ACI 301 and 318.
- B. Maintain copy of each standard affecting Work of this Section on Site.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Absorptive Mats Type C:





1. Description:
  - a. Material: Burlap-polyethylene (PE).
  - b. Minimum Weight: 9 oz./sq. yd.
  - c. Bonded to prevent separation during handling and placing.

B. Water: Potable; not detrimental to concrete.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that substrate surfaces are ready to be cured.

### 3.2 APPLICATION

- A. Horizontal Surfaces:
  1. Comply with ACI 308.
  2. Ponding: Maintain 100 percent coverage of water over floor slab areas continuously for four days.
  3. Spraying: Spray water over floor slab areas and maintain wet for seven days.
  4. Absorptive Mat:
    - a. Spread cotton fabric over floor slab areas.
    - b. Spray with water until mats are saturated and maintain in saturated condition for seven days.
  5. Absorptive Mat:
    - a. Saturate burlap-PE and place burlap-side down over floor slab areas.
    - b. Lap ends and sides.
    - c. Maintain in place for seven days.
  6. Membrane-Curing Compound: Apply curing compound in two coats with second coat applied at right angles to first.
  7. PE Film:
    - a. Spread over floor slab areas.
    - b. Lap edges and sides.
    - c. Seal with pressure-sensitive tape.
    - d. Maintain in place for seven days.
- B. Vertical Surfaces:
  1. Comply with ACI 308.
  2. Spraying: Spray water over surfaces and maintain wet for seven days.
  3. Membrane-Curing Compound: Apply compound in two coats with second coat applied at right angles to first.
  4. Non-membrane-Forming Curing Compound:
    - a. Apply curing compound in one.



- b. Maintain surface wet with curing compound, without ponding, for time as recommended by manufacturer.

### 3.3 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not permit traffic over unprotected floor surfaces.

END OF SECTION



## SECTION 03 60 00

### GROUTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Portland cement grout.
  - 2. Rapid-curing epoxy grout.
  - 3. Nonshrink cementitious grout.
- B. Related Requirements:
  - 1. Section 03 10 00 - Concrete Forming and Accessories: Form materials, waterstops, and accessories as required to form cast-in-place concrete and maintain structural integrity until stripping.
  - 2. Section 03 30 00 - Cast-in-Place Concrete: Cast-in-place or in-situ concrete for structural building frames, slabs on fill or grade, and other concrete components.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.
- B. Grout:
  - 1. Basis of Measurement: By cubic yard.
  - 2. Basis of Payment: Includes preparation of substrate and grout, placement, consolidation, troweling, and curing.

##### 1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 301 - Specifications for Structural Concrete for Buildings.
  - 2. ACI 301M - Specifications for Structural Concrete (Metric).
  - 3. ACI 318 - Building Code Requirements for Structural Concrete.
  - 4. ACI 318M - Metric Building Code Requirements for Structural Concrete.
- B. ASTM International:
  - 1. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
  - 2. ASTM C40/C40M - Standard Test Method for Organic Impurities in Fine Aggregates for Concrete.
  - 3. ASTM C150/C150M - Standard Specification for Portland Cement.
  - 4. ASTM C191 - Standard Test Methods for Time of Setting of Hydraulic Cement by Vicat Needle.
  - 5. ASTM C307 - Standard Test Method for Tensile Strength of Chemical-Resistant Mortar, Grouts, and Monolithic Surfacing.
  - 6. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.



7. ASTM C579 - Standard Test Methods for Compressive Strength of Chemical-Resistant Mortars, Grouts, Monolithic Surfacing, and Polymer Concretes.
8. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures.

- C. U. S. Army Corps of Engineers Concrete Research Division (CRD):
  1. CRD-C621 - Non-Shrink Grout.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer Instructions: Submit instructions for mixing, handling, surface preparation, and placing epoxy-type and nonshrink grouts.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
  1. Submit qualifications for manufacturer.

#### 1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate:
  1. Certify that products meet or exceed specified sustainable design requirements.
  2. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  1. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

#### 1.6 QUALITY ASSURANCE

- A. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.



## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Maximum Conditions: Do not perform grouting if temperatures exceed 90 degrees F
- C. Minimum Conditions: Maintain minimum temperature of 40degrees F before, during, and after grouting, until grout has set.

## PART 2 - PRODUCTS

### 2.1 PORTLAND CEMENT GROUT

- A. Portland Cement: Comply with ASTM C150/C150M, Type I and II.
- B. Water:
  - 1. Potable.
  - 2. No impurities, suspended particles, algae, or dissolved natural salts in quantities capable of causing:
    - a. Corrosion of steel.
    - b. Volume change increasing shrinkage cracking.
    - c. Efflorescence.
    - d. Excess air entraining.
- C. Fine Aggregate:
  - 1. Washed natural sand.
  - 2. Gradation:
    - a. Comply with ASTM C33/C33M.
    - b. Represented by smooth granulometric curve within required limits.
  - 3. Free from injurious amounts of organic impurities according to ASTM C40/C40M.
- D. Mix:
  - 1. Portland cement, sand, and water.
  - 2. Do not use ferrous aggregate or staining ingredients in grout mixes.



## 2.2 NONSHRINK CEMENTITIOUS GROUT

- A. Manufacturers:
- B. Description:
  - 1. Pre-mixed and ready-for-use formulation requiring only addition of water.
  - 2. Nonshrink, non-corrosive, nonmetallic, non-gas forming, and no chlorides.
- C. Performance and Design Criteria:
  - 1. Certified to maintain initial placement volume or expand after set, and to meet following minimum properties when tested according to CRD-C621 for Type D nonshrink grout:
    - a. Setting Time:
      - 1) Initial: Approximately two hours.
      - 2) Final: Approximately three hours.
      - 3) Comply with ASTM C191.
    - b. Maximum Expansion: 0.10 to 0.40 percent.
    - c. Compressive Strength:
      - 1) One-Day: 4,000 psi.
      - 2) Seven-Day: 7,000 psi.
      - 3) 28-Day: 10,000 to 10,800 psi.
      - 4) Comply with CRD-C621.

## 2.3 FORMWORK

- A. As specified in Section 03 10 00 - Concrete Forming and Accessories.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify areas to receive grout.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Remove defective concrete, laitance, dirt, oil, grease, and other foreign material from concrete surfaces by brushing, hammering, chipping, or other similar means until sound and clean concrete surface is achieved.
- C. Roughen concrete lightly, but not to interfere with placement of grout.
- D. Remove foreign materials from metal surfaces in contact with grout.
- E. Align, level, and maintain final positioning of components to be grouted.
- F. Saturate concrete surfaces with clean water, and then remove excess water.



### 3.3 INSTALLATION

#### A. Formwork:

1. Construct leakproof forms anchored and shored to withstand grout pressures.
2. Install formwork with clearances to permit proper placement of grout.
3. As specified in Section 03 10 00 - Concrete Forming and Accessories.

#### B. Mixing:

##### 1. Portland Cement Grout:

- a. Use proportions of two parts sand and one part cement, measured by volume.
- b. Prepare grout with water to obtain consistency to permit placing and packing.
- c. Mix water and grout in two steps:
  - 1) Premix using approximately 2/3 of water.
  - 2) After partial mixing, add remaining water to bring mix to desired placement consistency and continue mixing two to three minutes.
- d. Mix only quantities of grout capable of being placed within 30 minutes after mixing.
- e. Do not add additional water after grout has been mixed.

##### 2. Nonshrink Cementitious Grout:

- a. Mix and prepare according to manufacturer instructions.

3. Mix grout components in proximity to Work area and transport mixture quickly and in manner not permitting segregation of materials.

#### C. Placing of Grout:

1. Place grout material quickly and continuously.
2. Do not use pneumatic-pressure or dry-packing methods.
3. Apply grout from one side only to avoid entrapping air.
4. Do not vibrate placed grout mixture or permit placement if area is being vibrated by nearby equipment.
5. Thoroughly compact final installation and eliminate air pockets.
6. Do not remove leveling shims for at least 48 hours after grout has been placed.

#### D. Curing:

1. Prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by using wet burlap method.
2. Immediately after placement, protect grout from premature drying, excessively hot or cold temperatures, and mechanical injury.
3. After grout has attained its initial set, keep damp for minimum three days.

### 3.4 FIELD QUALITY CONTROL

#### A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

#### B. Testing:

1. Comply with ACI 301 and 318 and as specified in Section



2. Submit proposed mix design to Engineer of Record for review prior to commencement of Work.
3. Tests of grout components may be performed to ensure compliance with specified requirements.

END OF SECTION





## SECTION 04 05 13

### MASONRY MORTARING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Mortar for masonry.
- B. Related Requirements:
  - 1. Section 04 20 00 - Unit Masonry: Installation of mortar.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.
- B. Mortar Materials:
  - 1. Basis of Measurement: By cubic yd.
  - 2. Basis of Payment: Includes mortar materials and preparation ready for placement.
- C. Mortar in Place – Brick and Concrete Masonry Unit:
  - 1. Basis of Measurement: By square foot.
  - 2. Basis of Payment: Includes tooled mortar placement.

##### 1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
- B. ASTM International:
  - 1. ASTM C5 - Standard Specification for Quicklime for Structural Purposes.
  - 2. ASTM C91 - Standard Specification for Masonry Cement.
  - 3. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar.
  - 4. ASTM C150 - Standard Specification for Portland Cement.
  - 5. ASTM C199 - Standard Test Method for Pier Test for Refractory Mortars.
  - 6. ASTM C206 - Standard Specification for Finishing Hydrated Lime.
  - 7. ASTM C270 - Standard Specification for Mortar for Unit Masonry.
  - 8. ASTM C387 - Standard Specification for Packaged, Dry, Combined Materials for Concrete and High Strength Mortar.
  - 9. ASTM C595 - Standard Specification for Blended Hydraulic Cements.
  - 10. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry.
  - 11. ASTM C1142 - Standard Specification for Extended Life Mortar for Unit Masonry.
  - 12. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
  - 13. ASTM C1329 - Standard Specification for Mortar Cement.
  - 14. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength.



#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Design Data: Submit required environmental conditions, admixture limitations, and design mix if property specification of ASTM C270 is to be used.
- D. Test and Evaluation Reports:
  - 1. Indicate compliance of mortar to property requirements of ASTM C270, component mortar materials to requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency, and compressive strength.
- E. Manufacturer Instructions: Submit premixed mortar installation instructions.
- F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- G. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements:
  - 1. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  - 1. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

#### 1.6 QUALITY ASSURANCE

- A. Comply with ACI 530/530.1.
- B. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.



## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Cold Weather Requirements: Comply with ACI 530/530.1 if ambient temperature or temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: Comply with ACI 530/530.1 if ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Portland Cement:
  - 1. Comply with ASTM C150 Type I.
  - 2. Color: White.
- B. Masonry Cement:
  - 1. Comply with ASTM C91, Type N.
  - 2. Color: Gray.
- C. Premix Mortar:
  - 1. Comply with ASTM C387, Type N.
  - 2. Cement Color: Gray.
- D. Mortar Aggregate:
  - 1. Comply with ASTM C144.
  - 2. Type: Standard masonry.
- E. Hydrated Lime: Comply with ASTM C207, Type N.
- F. Water: Clean and potable.
- G. Mortar Color:
  - 1. Description: Mineral oxide pigment.



2. Color: to match existing.

H. Water Repellents:

1. Type: Liquid.

I. Calcium Chloride: Not allowed.

## 2.2 MIXES

A. Mortar Mixes:

1. Mortar for Structural Masonry: Comply with ASTM C270, Type N using proportion specification.
2. Mortar for Non-Structural Masonry: Comply with ASTM C270, Type N using proportion specification.
3. Pointing Mortar: Comply with ASTM C270, Type N using proportion specification.
4. Stain-Resistant Pointing Mortar:
  - a. One part Portland cement, 1/8 part hydrated lime, and two parts aggregate graded 80 mesh, proportioned by volume.
  - b. Add aluminum tristearate, calcium stearate, or ammonium stearate equal to 2 percent of Portland cement by weight.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Apply bonding agent to existing concrete surfaces.
- C. Mortar Mixing:
1. Thoroughly mix mortar ingredients according to ASTM C270 in quantities needed for immediate use.
  2. Achieve uniformly damp sand immediately before mixing process.
  3. Add mortar color and admixtures to achieve uniform mix and coloration.
  4. Retemper only within two hours of mixing.

### 3.2 INSTALLATION

- A. According to ACI 530/530.1.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Establish mortar mix according to ASTM C270.

END OF SECTION



## SECTION 04 05 16

### MASONRY GROUTING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Grout for masonry.
- B. Related Requirements:
  - 1. Section 04 20 00 - Unit Masonry: Installation of grout.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

- A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.
- B. Grout Materials:
  - 1. Basis of Measurement: By cubic yd.
  - 2. Basis of Payment: Includes grout materials and preparation ready for placement.
- C. Grout in Place – Brick and Concrete Masonry Unit:
  - 1. Basis of Measurement: By square foot.
  - 2. Basis of Payment: Includes grout placement, tooled.

##### 1.3 REFERENCE STANDARDS

- A. American Concrete Institute:
  - 1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures.
- B. ASTM International:
  - 1. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
  - 2. ASTM C143 - Standard Test Method for Slump of Hydraulic-Cement Concrete.
  - 3. ASTM C150 - Standard Specification for Portland Cement.
  - 4. ASTM C404 - Standard Specification for Aggregates for Masonry Grout.
  - 5. ASTM C476 - Standard Specification for Grout for Masonry.
  - 6. ASTM C1019 - Standard Test Method for Sampling and Testing Grout.
  - 7. ASTM C1157 - Standard Performance Specification for Hydraulic Cement.
  - 8. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Test and Evaluation Reports: Submit compliance with grout property requirements according to ASTM C476, component grout materials according to ASTM C476, and test and evaluation reports according to ASTM C1019.



- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

#### 1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify that following products meet or exceed specified sustainable design requirements.
  - 1. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  - 1. Provide cost data for following products:
    - a. Products with recycled material content.
    - b. Regional products.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to ACI 530/530.1.
- B. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

#### 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Cold Weather Requirements: According to ACI 530/530.1 if ambient temperature or temperature of masonry units is less than 40 degrees F.



- C. Hot Weather Requirements: According to ACI 530/530.1 if ambient temperature is greater than 100 degrees F or if ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Portland Cement: Comply with ASTM C150.
- B. Blended Cement: Comply with ASTM C595.
- C. Blended Cement: Comply with ASTM C1157.
- D. Grout Aggregate: Comply with ASTM C404 fine.
- E. Fly Ash: Comply with ASTM C618.
- F. Water: Clean and potable.
- G. Calcium Chloride: Not allowed.

### 2.2 MIXES

- A. Grout:
  - 1. Grout for Non-Structural Masonry:
    - a. Compressive Strength: 2,000 psi at 28 days.
    - b. Slump: 8 to 11 inches.
    - c. Mixing: According to ASTM C476 fine.
  - 2. Grout for Structural Masonry:
    - a. Compressive Strength: 2,000 psi at 28 days.
    - b. Slump: 8 to 11 inches.
    - c. Mixing: According to ASTM C476 fine.
  - 3. Application:
    - a. Coarse Grout: Grouting spaces with minimum 4-inch dimension in each direction.
    - b. Fine Grout: Grouting other spaces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Request inspection of spaces to be grouted.

### 3.2 INSTALLATION

- A. Mixing:
  - 1. Mix grout according to ASTM C94, as modified to use ingredients complying with ASTM C476.



- B. Comply with ACI 530/530.1.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Testing:
  - 1. Mix: Comply with ASTM C1019 for compressive strength, and comply with ASTM C143 for slump.
  - 2. Compressive Strength of Mortar, Grout, and Masonry: Comply with ASTM C1314.

### 3.4 ATTACHMENTS

- A. Masonry Bond Beams and Grouted Core Cells: 2,000 psi grout, fine aggregate.
- B. Masonry Pilasters: 4,000 psi grout, coarse aggregate.

END OF SECTION





## SECTION 04 20 00

### UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Brick and Concrete masonry units.

B. Related Requirements:

1. Section 03 20 00 - Concrete Reinforcing: Product requirements for steel reinforcing in masonry cores for installation by this Section.
2. Section 04 05 14 - Masonry Mortaring and Grouting: Mortar and grout.
3. Section 05 50 00 - Metal Fabrications: Product requirements for loose steel lintels for placement by this Section.
4. Section 07 21 13 - Board Insulation: Insulation for cavity spaces.
5. Section 07 21 19 - Foamed-In-Place Insulation: Foam insulation installed in masonry unit cores.
6. Section 07 27 00 - Air Barriers: Air barrier placed.
7. Section 07 90 00 - Joint Protection: Rod and sealant at control and expansion joints.

##### 1.2 REFERENCE STANDARDS

A. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures and Related Commentaries.

B. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A153- Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
5. ASTM A580 - Standard Specification for Stainless Steel Wire.
6. ASTM A615 - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
9. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.



10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
11. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.
12. ASTM C34 - Standard Specification for Structural Clay Load-Bearing Wall Tile.
13. ASTM C55 - Standard Specification for Concrete Building Brick.
14. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile.
15. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
16. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
17. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).
18. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
19. ASTM C126 - Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
20. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
21. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
22. ASTM C212 - Standard Specification for Structural Clay Facing Tile.
23. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
24. ASTM C315 - Standard Specification for Clay Flue Liners and Chimney Pots.
25. ASTM C530 - Standard Specification for Structural Clay Nonloadbearing Screen Tile.
26. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
27. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
28. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
29. ASTM C1261 - Standard Specification for Firebox Brick for Residential Fireplaces.
30. ASTM C1283 - Standard Practice for Installing Clay Flue Lining.
31. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
32. ASTM C1405 - Standard Specification for Glazed Brick (Single Fired, Brick Units).
33. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt used in Roofing and Waterproofing.
34. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
35. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.



### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with installation of window and door frame anchors and installation of structural framing supported by masonry.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  - 1. Submit data for fabricated wire reinforcement, wall ties, anchors, cavity and other accessories.
  - 2. Indicate initial rate of absorption for clay and shale brick.
- C. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statements:
  - 1. Submit qualifications for installer.

### 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Perform Work according to ACI 530/530.1.

### 1.6 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

### 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Do not store reinforcing material directly on ground. Utilize blocking and other methods to prevent rust on accessories prior to installation.
- C. Cold Weather Requirements: According to ACI 530.1 when ambient temperature or temperature of masonry units is less than 40 degrees F



- D. Hot Weather Requirements: According to ACI 530.1 when ambient temperature is greater than 100 degrees F or ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph

## 1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify elevations, dimensions, and alignment of foundations and other supporting construction prior to beginning Work. Indicate field measurements on Shop Drawings.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Concrete Masonry Compressive Strength (f'm): 2,000 psi; determined by unit strength method.

### 2.2 MATERIALS

- A. Hollow Load-Bearing CMU: ASTM C90; normal weight.

### 2.3 ACCESSORIES

- A. Single-Wythe Joint Reinforcement: ASTM A951 truss type; steel 0.148-inch diameter side rods with 0.148-inch -diameter cross ties.
- B. Reinforcing Steel: As specified in Section 03 20 00 - Concrete Reinforcing.
- C. Dovetail Anchors: 3/16" Diameter Wire, extend into Masonry Veneer minimum of 2" ASTM A153, hot-dip galvanize.
- D. Mortar and Grout: As specified in Section 04 05 14 - Masonry Mortaring and Grouting.
- E. Integral Flashings.
- F. Plastic Flashings: Sheet neoprene 20 mil thick.
- G. Lap Sealant: As specified in Section 07 90 00 - Joint Protection.
- H. Preformed Control Joints: Rubber material. Furnish with corner and T-accessories, cement-fused joints.
- I. Joint Filler: Closed cell rubber; oversized 50 percent to joint width; self-expanding; 1/4" inch wide by maximum lengths.
- J. Masonry Core Insulation: Molded expanded polystyrene, ASTM C578, Type 1; insulation specially molded to fit into block cores at the block plant prior to shipment.
- K. Cavity Drain Material: Open polyethylene mesh thickness required to fill cavity space and shaped to ensure moisture drainage to cavity weeps.
- L. Building Paper: ASTM D226; Type II, No. 30 unperforated asphalt felt.



- M. Weeps: Preformed plastic tubes, cotton wick filled.
- N. Cavity Vents: Molded PVC grilles; UV and insect resistant;
- O. Consult masonry manufacturers for recommended cleaning materials and methods. This Section is for cleaning of new masonry; cleaning or restoration of existing masonry is specified in Section 04 01 00.
- P. Cleaning Solution: Non-acidic, not harmful to masonry Work or adjacent materials.
- Q. Steel Lintels: Sizes as indicated on Drawings; hot-dip galvanized.

## 2.4 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test brick efflorescence according to ASTM C67. Brick rated greater than "slightly effloresced" is not acceptable.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and ready to receive Work.
- C. Verify that items provided by other Sections of Work are properly sized and located.
- D. Verify that built-in items are in proper location and ready for roughing into masonry Work.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Direct and coordinate placement of metal anchors supplied to other Sections.
- C. Furnish temporary bracing during installation of masonry Work. Maintain in place until building structure provides permanent support.
- D. Wet clay and shale brick before laying when initial rate of absorption is greater than 30 g per min./30 sq. in. when tested according to ASTM C67.

### 3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated. Protect from displacement.
- B. Maintain masonry courses to uniform dimension. Form bed and head joints of uniform thickness.



- C. Coursing of CMU:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: To match existing.
- D. Coursing of Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: To match existing.
- E. Placing and Bonding:
  - 1. Lay solid masonry units in full bed of mortar, with full head joints.
  - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
  - 3. Buttering corners of joints or excessive furrowing of mortar joints are not permitted.
  - 4. Remove excess mortar as Work progresses.
  - 5. Interlock intersections and external corners.
  - 6. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment is required, remove mortar and replace.
  - 7. Perform Project Site cutting of masonry units with proper tools to assure straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- F. Fire-Rated Masonry Construction:
  - 1. Install fire-rated masonry in compliance with requirements of ASTM E119 and with the hourly rating indicated on the Drawings.
- G. Weeps and Vents: Furnish weeps and vents in outer wythe at 24inches o.c. horizontally above through-wall flashing, above shelf angles and lintel and at bottom of walls.
- H. Cavity Wall: Do not permit mortar to drop or accumulate into cavity air space or to plug weeps. Build inner wythe ahead of outer wythe to receive cavity insulation and air/vapor retarder adhesive.
  - 1. Install cavity drain material continuously for full height of cavity and above through-wall flashing.
- I. Joint Reinforcement and Anchorage - Single-Wythe Masonry:
  - 1. Install horizontal joint reinforcement 16 inches o.c.
  - 2. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 16inches each side of opening.
  - 3. Place joint reinforcement continuous in first joint below top of walls.
  - 4. Lap joint reinforcement ends minimum 6 inches.
- J. Joint Reinforcement and Anchorage - Masonry Veneer:
  - 1. Install horizontal joint reinforcement 16 inches o.c.
  - 2. Place masonry joint reinforcement in first horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
  - 3. Place joint reinforcement continuous in first joint below top of walls.
  - 4. Lap joint reinforcement ends minimum 6 inches.



5. Embed wall ties in masonry backing to bond veneer at maximum 16 inches o.c. vertically and 16 inches o.c. horizontally. Place wall ties at maximum 8 inches o.c. vertically within 8 inches of jamb of wall openings.
  6. mm) o.c. horizontally.
  7. Place wall ties at maximum 8 inches o.c. vertically within 8 inches of jamb of wall openings.
  8. Place wall ties at maximum 8 inches o.c. horizontally within 8 inches of head and sill of wall openings.
- K. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls above ledges, shelf angles, and lintels, and at bottom of walls and turn down on outside face to form drip.
  2. Turn flashing up minimum 8 inches and bed into mortar joint of masonry.
  3. Lap end joints minimum 6 inches and seal watertight.
  4. Turn flashing; fold and seal at corners, bends, and interruptions.
- L. Masonry Core Insulation Inserts:
- M. Install masonry core insulation inserts at masonry manufacturing plant prior to delivery to Site.
- N. Do not remove inserts except where specifically noted on Drawings. Ensure that all inserts are properly installed in each course prior to installing subsequent courses.
- O. Lintels:
1. Install loose steel and concrete masonry bond beam lintels over openings per drawings.
  2. Install reinforced unit masonry lintels over miscellaneous openings less than 12 inches wide where lintels are not scheduled or indicated.
  3. Do not splice reinforcing bars.
  4. Support and secure reinforcing bars from displacement.
  5. Place and consolidate grout fill without displacing reinforcing.
  6. Allow masonry lintels to attain specified strength before removing temporary supports.
  7. Maintain minimum 8-inch bearing on each side of opening.
- P. Grouted Components:
1. Reinforce bond beams and pilasters as indicated on Drawings. Maintain minimum of 1 inch clearance from bottom web.
  2. Lap splices bar diameters as required by code.
  3. Support and secure reinforcing bars from displacement.
  4. Place and consolidate grout fill without displacing reinforcing.
  5. At bearing locations, fill masonry cores with grout for minimum 12 inches both sides of opening.
- Q. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned.
  2. Place reinforcement bars as indicated on Drawings.



3. Splice reinforcement as indicated on Drawings.
4. Support and secure reinforcement from displacement.
5. Place and consolidate grout fill without displacing reinforcing.
6. Place grout according to ACI 530.1.

R. Control Joints:

1. Install control joints at the following maximum spacings, unless otherwise indicated on Drawings:
  - a. Exterior Walls: 20 feet o.c. and within 24 inches on one side of each interior and exterior corner.
  - b. Interior Walls: 30 feet o.c.
  - c. At changes in wall height.
2. Do not continue horizontal joint reinforcement through control joints.
3. Form control joint with sheet building paper bond breaker fitted to one side of hollow contour end of block unit. Fill resultant core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

S. Expansion Joints:

1. Form expansion joints by omitting mortar and cutting unit to form open space
2. Do not continue horizontal joint reinforcement through expansion joints.

T. Built-in Work:

1. As Work progresses, install built-in metal door frames, metal window frames and wood nailing strips and other items to be built in the Work and furnished by other Sections.
2. Install built-in items plumb and level.
3. Bed anchors of metal door frames in adjacent mortar joints. Fill frame voids solid with grout or mortar. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
4. Do not build in materials subject to deterioration.

U. Cutting and Fitting:

1. Cut and fit for chases, pipes, conduit, sleeves and grounds. Coordinate with other Sections of Work to provide correct size, shape, and location.
2. Obtain Architect/Engineer's approval prior to cutting or fitting masonry Work not indicated or where appearance or strength of masonry Work may be impaired.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.





- E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet.
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- H. Maximum Variation for Steel Reinforcement:
  - 1. Install reinforcement within the tolerances specified in ACI 530.1 for foundation walls.
  - 2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
  - 3. Plus or minus 1 inch when distance is between 8 and 24 inches.
  - 4. Plus or minus 1-1/4 inch when distance is greater than 24 inches. Plus or minus 2 inches from location along face of wall.

### 3.5 FIELD QUALITY CONTROL

- A. Section 014000 - Quality Requirements: Requirements for inspecting and testing.
- B. Brick Units: Test each type according to ASTM C67, 5 random units for each 50,000 units installed.
- C. CMU: Test each type according to ASTM C140.
- D. Prism Tests: Test compressive strength of completed reinforced masonry according to ASTM C1314.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove excess mortar and mortar smears as Work progresses.
- C. Replace defective mortar. Match adjacent Work.
- D. Clean soiled surfaces with cleaning solution. Coordinate with Work of specified water-repellent or surface coating.
- E. Use non-metallic tools in cleaning operations.

### 3.7 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.



- E. Protect tops of masonry Work with waterproof coverings secured in place without damaging masonry. Provide coverings where masonry is exposed to weather when Work is not in progress. Maintain protection on tops of completed exterior walls until installation of permanent waterproof cap materials.

### 3.8 ATTACHMENTS

- A. Exterior Wall: Composite masonry with exterior wythe of "dark brown" face brick veneer, bonded with wire ladder reinforcement to inner wythe of interior-facing, split-faced concrete block masonry (CMU) with 2 inch space for insulation.
- B. Interior Partitions: Single-wythe CMU.
- C. Interior Decorative Block Partitions: Scored masonry units at east wall of Entry 101.
- D. Interior Fire Walls: One- and two-hour walls of grout-filled concrete masonry with locations identified on Drawings.
- E. Interior Load-Bearing Walls: North and south walls of Mechanical Room 147.

END OF SECTION



## SECTION 04 27 23

### CAVITY WALL UNIT MASONRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Facebrick exterior wythe.
2. Concrete masonry interior wythe.
3. Reinforcement, anchorages, and accessories.

###### B. Related Requirements:

1. Section 03 20 00 - Concrete Reinforcing: Type requirements for reinforcing steel.
2. Section 04 05 14 - Masonry Mortaring and Grouting: Product requirements for mortar and grout.
3. Section 05 50 00 - Metal Fabrications: Product requirements for loose steel lintels for placement by this Section.
4. Section 07 21 13 - Board Insulation: Insulation for cavity spaces.
5. Section 07 27 00 - Air Barriers: Air barrier placed on interior face of wall insulation.
6. Section 07 90 00 - Joint Protection: Rod and sealant at control and expansion joints.

##### 1.2 REFERENCE STANDARDS

###### A. American Concrete Institute:

1. ACI 530/530.1 - Building Code Requirements and Specification for Masonry Structures and Related Commentaries.

###### B. ASTM International:

1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
3. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
4. ASTM A615 - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.
5. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A951 - Standard Specification for Steel Wire for Masonry Joint Reinforcement.
7. ASTM B370 - Standard Specification for Copper Sheet and Strip for Building Construction.
8. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
9. ASTM C27 - Standard Classification of Fireclay and High-Alumina Refractory Brick.



10. ASTM C55 - Standard Specification for Concrete Building Brick.
11. ASTM C56 - Standard Specification for Structural Clay Nonloadbearing Tile.
12. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale).
13. ASTM C67 - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile.
14. ASTM C73 - Standard Specification for Calcium Silicate Brick (Sand-Lime Brick).
15. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units.
16. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units.
17. ASTM C140 - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
18. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
19. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
20. ASTM C652 - Standard Specification for Hollow Brick (Hollow Masonry Units Made From Clay or Shale).
21. ASTM C744 - Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
22. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms.
23. ASTM C1405 - Standard Specification for Glazed Brick (Single Fired, Brick Units).
24. ASTM D226 - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
25. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
26. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:
  1. Submit data for masonry units, fabricated wire reinforcement, wall ties and cavity insulation and other accessories.



2. Indicate initial rate of absorption for clay and shale brick.
3. Submit qualifications for installer.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

#### 1.7 QUALITY ASSURANCE

- A. Perform Work according to ACI 530/530.1.
- B. Surface-Burning Characteristics:
  1. Foam Insulation: Maximum 75/450 flame-spread/smoke-developed index when tested according to ASTM E84.

#### 1.8 QUALIFICATIONS

- A. Installer: Company specializing in performing Work of this Section with minimum three years' experience.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Metallic Components:
  1. Do not store reinforcing material directly on ground.
  2. Use blocking and other methods to prevent rust on accessories prior to installation.

#### 1.10 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Cold Weather Requirements: According to ACI 530/530.1, when ambient temperature of masonry units is less than 40 degrees F.
- C. Hot Weather Requirements: According to ACI 530/530.1, when ambient temperature is greater than 100 degrees F or when ambient temperature is greater than 90 degrees F with wind velocity greater than 8 mph.

#### 1.11 EXISTING CONDITIONS

- A. Field Measurements:
  1. Verify field measurements prior to fabrication.
  2. Indicate field measurements on Shop Drawings.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Concrete Masonry Compressive Strength (f'm):
  - 1. 2,000 psi.
  - 2. Determined by unit strength method.
  - 3. CMU Minimum Net Area Compressive Strength: 2,650 psi.

### 2.2 MATERIALS

- A. Facing Brick:
  - 1. Comply with ASTM C216.
  - 2. Type: FBS.
  - 3. Grade: MW.
  - 4. Color: to match existing.
- B. Nominal Brick Size: to match existing
- C. Hollow Load-Bearing CMU:
  - 1. Comply with ASTM C90.
  - 2. Weight: Normal.
- D. Hollow Non-load-bearing CMU:
  - 1. Comply with ASTM C129.
  - 2. Weight: Normal.
- E. CMU:
- F. Nominal Modular Size: 8 by 8 by 16 inches.

### 2.3 MIXES

- A. Mortar and Grout: As specified in Section 04 05 13 – Masonry Mortaring and 04 05 16 – Masonry Grouting

### 2.4 ACCESSORIES

- A. Multiwythe Joint Reinforcement:
  - 1. Comply with ASTM A951
  - 2. Type: Ladder.
  - 3. Material: Steel.
  - 4. Side Rods Diameter: 0.148 inch.
  - 5. Cross Ties Diameter: 0.148 inch.
  - 6. Finish: ASTM A153, hot-dip galvanized.
- B. Reinforcing Steel: As specified in Section 03 20 00 - Concrete Reinforcing.
- C. Wall Ties:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:



- a. Hohmann & Barnard, Inc.
  - 2. Substitutions: Section 01 60 00 - Product Requirements.
  - 3. Description:
    - a. Material: ASTN A82 Steel Wire.
    - b. Hohmann & Barnard 2-SEAL BYNA-LOK WIRE TIE with 2-Seal Concrete Seal tie
    - c. Finish: ASTM A153, hot-dip galvanized.
  - D. Galvanized Steel:
    - 1. Material: Core steel.
    - 2. Comply with ASTM A653.
    - 3. Thickness: 26 gage.
    - 4. Finish: Comply with G90.
  - E. Preformed Control Joints:
    - 1. Material: Neoprene.
    - 2. Furnish with corner and T accessories and cement-fused joints.
    - 3. Profile: As indicated on Drawings.
  - F. Joint Filler:
    - 1. Description: Closed-cell polyurethane, oversized 50 percent to joint width.
    - 2. Type: Self-expanding.
  - G. Cavity Board Insulation: As specified in Section 07 21 13 – Cavity Wall Insulation.
  - H. Cavity Drain Material:
    - 1. Description: Open PE mesh, shaped to ensure moisture drainage to cavity weeps.
    - 2. Thickness: As required to fill cavity space.
  - I. Weeps: Preformed plastic tubes, cotton wick filled.
  - J. Cavity Vents:
    - 1. Description: Molded PVC grilles.
    - 2. UV and insect resistant.
    - 3. Color: as selected.
  - K. Cleaning Solution: Nonacidic and not harmful to masonry work or adjacent materials.
  - L. Steel Lintels:
    - 1. Size: As indicated on Drawings.
    - 2. Finish: ASTM A153, hot-dip galvanized.
- 2.5 SOURCE QUALITY CONTROL
- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
  - B. Efflorescence:
    - 1. Test brick efflorescence according to ASTM C67.
    - 2. Brick rated greater than "slightly effloresced" is not acceptable.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work of this Section.
- C. Verify that items provided by other Sections of Work are properly sized and located.
- D. Verify that built-in items are in proper location and are ready for roughing into masonry work.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Direct and coordinate placement of metal anchors supplied to other Sections of Work.
- C. Temporary Bracing:
  - 1. Furnish temporary bracing during installation of masonry work.
  - 2. Maintain in place until building structure provides permanent support.
- D. Wet clay and shale brick before laying if initial rate of absorption is greater than 30 g per min/30 sq. in. when tested according to ASTM C67.

### 3.3 INSTALLATION

- A. Establish lines, levels, and coursing indicated, and protect from displacement.
- B. Masonry:
  - 1. Maintain masonry courses to uniform dimension.
  - 2. Form bed and head joints of uniform thickness.
- C. Coursing of CMU:
  - 1. Bond: Running.
  - 2. Coursing: One unit and one mortar joint to equal 8 inches.
  - 3. Mortar Joints: To match existing.
- D. Coursing of Brick Units:
  - 1. Bond: Running.
  - 2. Coursing: Three units and three mortar joints to equal 8 inches.
  - 3. Mortar Joints: To match existing.
- E. Masonry Placement and Bonding:
  - 1. Lay solid masonry units in full bed of mortar, with full head joints.
  - 2. Lay hollow masonry units with face shell bedding on head and bed joints.
  - 3. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.





4. Remove excess mortar as Work progresses.
  5. Interlock intersections and external corners.
  6. Adjusting:
    - a. Do not shift or tap masonry units after mortar has achieved initial set.
    - b. If adjustment is required, remove mortar and replace.
  7. Perform Site cutting of masonry units with proper tools to ensure straight, clean, and unchipped edges.
- F. Weeps and Vents:
1. Furnish weeps and vents in outer wythe at 16 inches o.c. horizontally, above through-wall flashing, above shelf angles and lintels and at bottom of walls.
- G. Cavity Wall:
1. Do not permit mortar to drop, accumulate into cavity air space, or plug weeps.
  2. Build inner wythe ahead of outer wythe to receive cavity air barrier membrane as specified in Section 07 27 00 - Air Barriers.
  3. Install cavity drain material continuously at bottom of each cavity and above through-wall flashing.
- H. Joint Reinforcement and Anchorages:
1. Install horizontal joint reinforcement 16 inches o.c.
  2. Place masonry joint reinforcement in first horizontal joint above and below openings.
  3. Extend masonry joint reinforcement minimum 16 inches each side of opening.
  4. Place joint reinforcement continuous in first joint below top of walls.
  5. Lap joint reinforcement ends minimum 6 inches.
- I. Masonry Flashings:
1. Extend flashings horizontally through outer wythe at foundation walls, above ledge or shelf angles and lintels, and at bottom of walls; turn down on outside face to form drip.
  2. Turn flashing up minimum 8 inches and bed into mortar joint of masonry backing.
  3. Lap end joints minimum 6 inches and seal watertight.
  4. Turn flashing, fold, and seal at corners, bends, and interruptions.
- J. Masonry Core Insulation Inserts:
1. Install masonry core insulation inserts at masonry manufacturing plant prior to delivery to Site.
  2. Do not remove inserts except where specifically noted on Drawings.
  3. Ensure that all inserts are properly installed in each course prior to installing subsequent courses.
- K. Lintels:
1. Install loose steel and concrete masonry bond beam lintels over openings per drawings.
  2. Install reinforced unit masonry lintels over miscellaneous openings less than 12 inches wide where steel or precast concrete lintels are not scheduled.
    - a. Do not splice reinforcing bars.
    - b. Support and secure reinforcing bars from displacement.
    - c. Place and consolidate grout fill without displacing reinforcing.



- d. Allow masonry lintels to attain specified strength before removing temporary supports.
  3. Maintain minimum 8 inch bearing on each side of opening.
- L. Grouted Components:
1. Reinforce bond beams and pilasters as shown on Drawings.
  2. Maintain minimum of 1-inch clearance from bottom web.
  3. Lap splices bar diameters as required by code.
  4. Support and secure reinforcing bars from displacement.
  5. Place and consolidate grout fill without displacing reinforcing.
  6. At bearing locations, fill masonry cores with grout for minimum 12 inches on both sides of opening.
- M. Reinforced Masonry:
1. Lay masonry units with cells vertically aligned and cavities between wythes clear of mortar and unobstructed.
  2. Place reinforcement bars as indicated on Drawings.
  3. Splice reinforcement as indicated on Drawings.
  4. Support and secure reinforcement from displacement.
  5. Place and consolidate grout fill without displacing reinforcing.
  6. Place grout according to ACI 530/530.1.
- N. Control Joints:
1. Install control joints at following maximum spacings, unless otherwise indicated on Drawings:
    - a. Exterior Walls: 20 feet o.c. and within 24 inches on one side of each interior and exterior corner.
    - b. Interior Walls: 30 feet o.c.
    - c. At changes in wall height.
  2. Do not continue horizontal joint reinforcement through control joints.
  3. Control Joints:
    - a. Install preformed control joint device in continuous lengths.
    - b. Seal butt and corner joints.
  4. Size control joint as specified in Section 07 90 00 - Joint Protection for sealant performance.
- O. Built-In Work:
1. As Work progresses, install built-in metal door frames, metal window frames and other items to be built into the Work and furnished by other Sections.
  2. Install built-in items plumb and level.
  3. Door Frames:
    - a. Bed anchors of metal door frames in adjacent mortar joints.
    - b. Fill frame voids solid with grout or mortar.
    - c. Fill adjacent masonry cores with grout, minimum 12 inches from framed openings.
  4. Do not build in materials that are subject to deterioration.
- P. Cutting and Fitting:
1. Cut and fit for chases, pipes, conduit, sleeves, grounds.



2. Coordinate with other Sections of Work to provide correct size, shape, and location.
3. Obtain Architect/Engineer's approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.
- C. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- D. Maximum Variation from Plumb: 1/4 inch per story noncumulative; 1/2 inch in two stories or more.
- E. Maximum Variation from Level Coursing: 1/8 inch in 3 feet, 1/4 inch in 10 feet , and 1/2 inch in 30 feet.
- F. Maximum Variation of Joint Thickness: 1/8 inch in 3 feet .
- G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.
- H. Maximum Variation for Steel Reinforcement:
  1. Install reinforcement within the tolerances according to ACI 530/530.1 for foundation walls.
  2. Plus or minus 1/2 inch when distance from centerline of steel to opposite face of masonry is 8 inches or less.
  3. Plus or minus 1 inch when distance from centerline of steel to opposite face of masonry is between 8 and 24 inches.
  4. Plus or minus 1-1/4 inch when distance from centerline of steel to opposite face of masonry is greater than 24 inches.
  5. Plus or minus 2 inches from location along face of wall.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Testing:
  1. Brick Units:
    - a. Test each type according to ASTM C67.
    - b. Test five random units for each 50,000 units installed.
  2. CMU: Test each type according to ASTM C140.
  3. Prism Tests: Test compressive strength of completed reinforced masonry according to ASTM C1314.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove excess mortar and mortar smears as Work progresses.



- C. Replace defective mortar.
- D. Match adjacent Work.
- E. Clean soiled surfaces with cleaning solution.
- F. Use nonmetallic tools in cleaning operations.

### 3.7 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect exposed external corners subject to damage.
- C. Protect base of walls from mud and mortar splatter.
- D. Protect masonry and other items built into masonry walls from mortar droppings and staining caused by mortar.
- E. Coverings:
  - 1. Protect tops of masonry work with waterproof coverings secured in place without damaging masonry.
  - 2. Provide coverings where masonry is exposed to weather when Work is not in progress.
  - 3. Maintain protection on tops of completed exterior walls until installation of permanent waterproof cap materials.

END OF SECTION



## SECTION 05 12 00

### STRUCTURAL STEEL FRAMING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

A. Section Includes:

1. Structural shapes.
2. Channels and angles.
3. Hollow structural sections.
4. Structural pipe.
5. Structural plates.
6. Floor plates.
7. Bolts, connectors, and anchors.
8. Grout.

B. Related Requirements:

1. Section 03 60 00 - Grouting: Grout for setting base plates.
2. Section 05 50 00 - Metal Fabrications: Steel fabrications affecting structural steel work.

##### 1.2 UNIT PRICE - MEASUREMENT AND PAYMENT

A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.

B. Structural Steel Framing:

1. Basis of Measurement: By the ton.
2. Basis of Payment: Includes structural members fabricated, installed, and anchored.

##### 1.3 REFERENCE STANDARDS

A. American Institute of Steel Construction:

1. AISC 303 - Code of Standard Practice for Structural Steel Buildings and Bridges.
2. AISC 341 - Seismic Provisions for Structural Steel Buildings.
3. AISC 360 - Specification for Structural Steel Buildings.

B. American Society of Civil Engineers:

1. ASCE 19 - Structural Applications of Steel Cables for Buildings.

C. American Welding Society:

1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
2. AWS D1.1 - Structural Welding Code - Steel.



3. AWS D1.1M - Structural Welding Code - Steel.

D. ASTM International:

1. ASTM A36 - Standard Specification for Carbon Structural Steel.
2. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished.
3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
4. ASTM A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications.
5. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
7. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
8. ASTM A449 - Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use.
9. ASTM A490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
10. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
11. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
12. ASTM A514 - Standard Specification for High-Yield-Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding.
13. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
14. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
15. ASTM A913 - Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process.
16. ASTM A992 - Standard Specification for Structural Steel Shapes.
17. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
18. ASTM E94 - Standard Guide for Radiographic Examination.
19. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments.
20. ASTM E165 - Standard Practice for Liquid Penetrant Examination for General Industry.
21. ASTM E709 - Standard Guide for Magnetic Particle Testing.
22. ASTM F436 - Standard Specification for Hardened Steel Washers.
23. ASTM F959 - Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners.



24. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
25. ASTM F1852 - Standard Specification for "Twist Off" Type Tension Control Structural Bolt/Nut/Washer Assemblies, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
26. ASTM F2329 - Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners.

E. California Department of Health Services:

1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.

F. Green Seal:

1. GC-03 - 2nd Edition, January 7, 1997 - Anti-Corrosive Paints.

G. Research Council on Structural Connections:

1. RCSC - Specification for Structural Joints Using ASTM A325 (A325) or A490 (A490) Bolts.

H. SSPC: The Society for Protective Coatings:

1. SSPC - Steel Structures Painting Manual.
2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
4. SSPC SP 3 - Power Tool Cleaning.
5. SSPC SP 6 - Commercial Blast Cleaning.
6. SSPC SP 10 - Near-White Blast Cleaning.

#### 1.4 COORDINATION

A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

B. Coordinate Work of this Section with following:

1. Section 05 50 00 - Metal Fabrications for miscellaneous steel supports other than structural steel.

#### 1.5 SUBMITTALS

A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

B. Shop Drawings:

1. Indicate sizes, spacing and locations of structural members, attachments and bolts.
2. Connections.
3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.

C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.



- D. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- E. Mill Test Reports: Submit indicating structural strength, destructive and non-destructive test analysis
- F. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
  - 1. Submit qualifications for fabricator, erector, shop painter, and welders.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to following:
  - 1. Structural Steel: AISC 303 and AISC 360.
  - 2. Architecturally Exposed Structural Steel: AISC 303, Section 10.
  - 3. High-Strength Bolted Connections: RCSC - Specification for Structural Joints Using ASTM A325 or ASTM A490 Bolts.
  - 4. Steel Cable Structures: ASCE 19.
- B. Maintain copy of each standard affecting the Work of this Section on-site.

#### 1.7 QUALIFICATIONS

- A. Fabricator:
  - 1. Company specializing in fabricating products specified in this Section with minimum three years' experience with following current AISC Certification:
    - a. Standard Steel Building Structures (STD).
    - b. Conventional Steel Building Structures (SBD).
- B. Erector:
  - 1. Company specializing in performing Work of this Section with minimum three years' experience
- C. Shop Painter:
  - 1. Company specializing in performing Work of this Section with minimum three years' experience with following current AISC Certification:
    - a. Sophisticated Paint Endorsement - Enclosed (P1).
    - b. Sophisticated Paint Endorsement - Covered (P2).
    - c. Sophisticated Paint Endorsement - Outside (P3).
- D. Welders and Welding Procedures: AWS D1.1 qualified within previous 12 months.





## PART 2 - PRODUCTS

### 2.1 STRUCTURAL STEEL

- A. Structural W-Shapes: ASTM A992.
- B. Structural T-Shapes: Cut from structural W-shapes.
- C. Channels and Angles: ASTM A36 Consider following Subparagraph for corrosion-resistant weathering steel. ASTM A588 (A588M) steel is available in Grades A, B, C, and K, depending on chemical composition.
- D. Rectangular, Hollow Structural Sections: ASTM A500, Grade C.
- E. Structural Plates and Bars: ASTM A36.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Bolts: Heavy-hex, structural type.
  - 1. ASTM A307 hot-dip galvanized plain.
- B. Nuts: ASTM A563 heavy-hex type.
  - 1. Finish: Hot-dip galvanized.
- C. Washers:
  - 1. ASTM F436.
  - 2. Type 1, circular.
  - 3. Finish: Hot-dip galvanized.
- D. Anchor Rods:
  - 1. ASTM F1554 Grade 36.
  - 2. Shape: Straight.
  - 3. Plate Washers: ASTM A36.
- E. Threaded Rods:
  - 1. ASTM A36.
  - 2. Finish: Hot-dip galvanized.

### 2.3 WELDING MATERIALS

- A. Welding Materials:
  - 1. AWS D1.1.
  - 2. Type required for materials being welded.

### 2.4 FABRICATION

- A. Continuously seal joined members by continuous welds. Grind exposed welds smooth.
- B. Fabricate connections for bolt, nut, and washer connectors.



- C. Develop required camber for members.

## 2.5 FINISHES

- A. Prepare structural component surfaces according to SSPC SP 6.
- B. Shop-prime structural steel members. Do not prime surfaces that will be field welded.

## 2.6 ACCESSORIES

- A. Grout:
  - 1. Non-shrink type; premixed compound consisting of nonmetallic aggregate, cement, water-reducing, and plasticizing additives.
  - 2. Capable of developing minimum compressive strength of 7,000 psi at 28 days.
- B. Shop Primer: SSPC Paint 15, Type 1, red oxide.
- C. Touchup Primer: Match shop primer.

## 2.7 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Testing: Test bolted and welded connections as specified in PART 3 for field quality control tests.
- C. Certificate of Compliance: When fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at fabricator's facility conforms to Contract Documents.
  - 1. Specified shop tests are not required for Work performed by approved fabricator.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that bearing surfaces are at correct elevation.
- C. Verify that anchor rods are set in correct locations and arrangements, with correct exposure for steel attachment.

## 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.



- B. Furnish templates for installation of anchor rods and embedments in concrete and masonry work.

### 3.3 ERECTION

- A. Allow for erection loads and for sufficient temporary bracing to maintain structure safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
- B. Field-weld components as indicated on Drawings.
- C. Field-connect members with threaded fasteners; torque to required resistance and snug-tighten for bearing-type connection.
- D. Do not field-cut or alter structural members without approval of Architect/Engineer.
- E. After erection, touch up welds and abrasions to match shop finishes.

### 3.4 GROUT INSTALLATION

- A. Shim bearing plates and equipment supports to proper elevation, and snug-tighten anchor bolts.
- B. Fill void under bearing surface with grout; install and pack grout to remove air pockets.
- C. Moist-cure grout.
- D. Remove forms after grout is set; trim grout edges to form smooth surface, splayed 45 degrees.
- E. Tighten anchor bolts after grout has cured for a minimum of three days.

### 3.5 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- C. Maximum Offset from Alignment: 1/4 inch.

### 3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- C. Bolted Connections: Inspect according to AISC 303.
  - 1. Visually inspect all bolted connections.



2. Direct Tension Indicators: Comply with requirements of ASTM F959, and verify that gaps are less than gaps specified in Table 2.
- D. Welding: Inspect welds according to AWS D1.1.
1. Use certified welders, and conduct inspections and tests as required. Record types and locations of defects found in Work. Record work required and performed to correct deficiencies.
  2. Visually inspect all welds.
  3. Ultrasonic Inspection: ASTM E164; perform on each full-penetration weld.
  4. Liquid Penetrant Inspection: ASTM E165.
  5. Magnetic Particle Inspection: ASTM E709; performed on.
  6. Radiographic Inspection: ASTM E94; performed on.
- E. Correct defective bolted connections and welds.

END OF SECTION



## SECTION 05 50 00

### METAL FABRICATIONS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Shop-fabricated metal items.
2. Loose steel lintels.
3. Channel door frames.
4. Structural supports for miscellaneous attachments.
5. Anchor bolts for sill plates.

###### B. Related Requirements:

1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for embedded anchors and attachments for metal fabrications specified by this Section in concrete.
2. Section 04 20 00 - Unit Masonry: Execution requirements for embedded anchors and attachments for metal fabrications specified by this Section in masonry.
3. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.

##### 1.2 UNIT PRICES

###### A. Section 01 20 00 - Price and Payment Procedures: Contract Sum/Price modification procedures.

###### B. Steel Lintels

1. Basis of Measurement: By the pound.
2. Basis of Payment: Includes fabrication, finishing, and installation.

##### 1.3 REFERENCE STANDARDS

###### A. Aluminum Association:

1. AA DAF-45 - Designation System for Aluminum Finishes.

###### B. American Architectural Manufacturers Association:

1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
3. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
4. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.



- C. American National Standards Institute:
  - 1. ANSI A14.3 - American National Standard (ASC) for Ladders - Fixed - Safety Requirements.
- D. American Welding Society:
  - 1. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination.
  - 2. AWS D1.1 - Structural Welding Code – Steel.
- E. ASTM International:
  - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
  - 2. ASTM A53- Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 5. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
  - 6. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength.
  - 7. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
  - 8. ASTM A354 - Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners.
  - 9. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - 10. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  - 11. ASTM A554 - Standard Specification for Welded Stainless Steel Mechanical Tubing.
  - 12. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
  - 13. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 14. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - 15. ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
  - 16. ASTM A992 - Standard Specification for Structural Steel Shapes.
  - 17. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 18. ASTM F436 - Standard Specification for Hardened Steel Washers.
  - 19. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength.



- F. Builders Hardware Manufacturers Association (BHMA):
  - 1. ANSI/BHMA A156.20 - American National Standard for Strap and Tee Hinges and Hasps.
- G. California Department of Health Services:
  - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- H. Green Seal:
  - 1. GC-03- 2nd Edition, January 7, 1997 - Anti-Corrosive Paints.
- I. National Ornamental & Miscellaneous Metals Association:
  - 1. NOMMA Guideline 1 - Joint Finishes.
- J. SSPC: The Society for Protective Coatings:
  - 1. SSPC - Steel Structures Painting Manual.
  - 2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
  - 3. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
  - 4. SSPC SP 1 - Solvent Cleaning.
  - 5. SSPC SP 10 - Near-White Blast Cleaning.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.
- D. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- E. Qualifications Statement:
  - 1. Submit qualifications for licensed professional.

#### 1.5 QUALITY ASSURANCE

- A. Finish joints according to NOMMA Guideline 1.
- B. Maintain copy of each standard affecting the Work of this Section on-site.



## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept metal fabrications on-Site in labeled shipments. Inspect for damage.
- C. Protect metal fabrications from damage by exposure to weather or by ground contact.

## 1.7 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

# PART 2 - PRODUCTS

## 2.1 LINTELS

- A. Description:
  - 1. Steel sections.
  - 2. Size and Configuration:
    - a. As indicated on Drawings.
    - b. Length to allow 8 inch minimum bearing on both sides of opening.
  - 3. Exterior Location Finish Prime paint, one coat.
  - 4. Interior Location Finish: Prime paint, one coat.

## 2.2 ANCHORS

- A. Description:
  - 1. ASTM F1554; Grade 36, weldable and ASTM A307; Grade A.
  - 2. Shape: Straight.
  - 3. Furnish with nut and washer per drawings.
  - 4. Finish: None.
- B. Steel:
  - 1. Channels and Angles: ASTM A36.
  - 2. Steel Plate: ASTM A36
  - 3. Hollow Structural Sections: ASTM A500 Grade B.
  - 4. Bolts: ASTM A307; Grade A or B and ASTM A325; Type 1].
  - 5. Nuts: ASTM A563; heavy-hex type.
  - 6. Washers: ASTM F436 ; Type 1.
  - 7. Welding Materials: AWS D1.1; type required for materials being welded.

## 2.3 FABRICATION

- A. Fit and shop-assemble items in largest practical sections for delivery to Site.
- B. Fabricate items with joints tightly fitted and secured.





- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small, uniform radius.
- E. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- F. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- G. Fabrication Tolerances:
  - 1. Squareness: 1/8-inch maximum difference in diagonal measurements.
  - 2. Maximum Offset between Faces: 1/16 inch.
  - 3. Maximum Misalignment of Adjacent Members: 1/16-inch.
  - 4. Maximum Bow: 1/8 inch in 48 inches.
  - 5. Maximum Deviation from Plane: 1/16 inch in 48 inches.

## 2.4 FINISHES

- A. Steel:
  - 1. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
  - 2. Do not prime surfaces in direct contact with concrete or where field welding is required.
  - 3. Prime-paint items with one coat except where galvanizing is specified.
  - 4. Galvanizing for Fasteners, Connectors, and Anchors:
    - a. Hot-Dip Galvanizing: ASTM A153 (A153M).
    - b. Mechanical Galvanizing: ASTM B695; Class 50 minimum.
  - 5. Bolts: Hot-dip galvanized.
  - 6. Nuts: Hot-dip galvanized.
  - 7. Washers: Hot-dip galvanized.
  - 8. Shop Primer: SSPC Paint 15, Type 1, red oxide.
  - 9. Touchup Primer: Match shop primer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.



### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip primed steel items to bare metal where Site welding is required.
- C. Supply steel items required to be cast into concrete with setting templates to appropriate sections.

### 3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, and free from distortion or defects.
- B. Make provisions for erection stresses. Install temporary bracing to maintain alignment until permanent bracing and attachments are installed.
- C. Field-weld components indicated on Drawings.
- D. Perform field welding according to AWS D1.1.
- E. Obtain approval of Architect/Engineer prior to Site cutting or making adjustments not scheduled.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story or for every 12 feet in height, whichever is greater, non-cumulative.
- C. Maximum Variation from Level: 1/16 inch in 3 feet and 1/4 inch in 10 feet.
- D. Maximum Offset from Alignment: 1/4 inch.
- E. Maximum Out-of-Position: 1/4 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Welding: Inspect welds according to AWS D1.1.
- C. Replace damaged or improperly functioning hardware.
- D. After erection, touch up welds, abrasions, and damaged finishes with prime paint or galvanizing repair paint to match shop finishes.
- E. Touch up factory-applied finishes according to manufacturer-recommended procedures.

END OF SECTION



## SECTION 05 52 00

### METAL RAILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Steel pipe and tube railings, balusters, and fittings.
  - 2. Handrails.
- B. Related Requirements:
  - 1. Section 03 30 00 - Cast-In-Place Concrete: Execution requirements for placement of anchors, as specified in this Section, in concrete.
  - 2. Section 09 90 00 - Painting and Coating: Paint finish.
  - 3. Section 05 50 00 – Metal fabrications: Attachment plates and angles for anchorage.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
  - 2. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
  - 3. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  - 4. ASTM A501 – Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  - 5. ASTM A513 – Standard Specification for Electric Resistance-Welded Carbon and Alloy Steel Mechanical Tubing.
  - 6. ASTM B177 - Standard Guide for Engineering Chromium Electroplating.
  - 7. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- B. National Association of Architectural Metal Manufacturers:
  - 1. NAAMM Metal Finishes Manual.
- C. SSPC: The Society for Protective Coatings:
  - 1. SSPC - Steel Structures Painting Manual.
  - 2. SSPC Paint 15 - Steel Joist Shop Primer/Metal Building Primer.
  - 3. SSPC Paint 20 - Zinc-Rich Coating, Type I - Inorganic and Type II - Organic.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.



- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

#### 1.4 QUALITY ASSURANCE

- A. Perform Work of this Section according to ASTM E985.
- B. Finish joints according to NOMMA Guideline 1.
- C. Perform Work according to Maine Department of Education Standards.

#### 1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' experience.

#### 1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design handrail, guardrail, and attachments to resist forces as required by applicable code. Apply loads non-simultaneously to produce maximum stresses.
  - 1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.

#### 2.2 HANDRAILS AND RAILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Pisor Industries, Inc.
  - 2. Wagner, R & B, Inc.; a division of the Wagner Companies.
- B. Substitutions: Section 016000 Product Requirements.
  - 1. Furnish materials according to Maine Department of Education standards.

#### 2.3 MATERIALS

- A. Steel Railing System:
  - 1. Rails and Posts: 1-1/2-inch diameter steel tubing, welded joints.
  - 2. Pickets: ½ inch diameter steel tubing, welded joints.
  - 3. Fittings: Elbows, T-shapes, escutcheons, cast steel.



4. Mounting: Adjustable brackets and flanges, with steel inserts for casting in concrete.
5. Exposed Fasteners: Flush countersunk screws or bolts, consistent with design of railing.
6. Splice Connectors: Steel welding collars.

B. Shop Prefinishing: Epoxy coated; color as selected by Architect.

## 2.4 FABRICATION

- A. Fit and shop-assemble components in largest practical sizes for delivery to Site.
- B. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate Site assembly and installation.
- C. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.
- F. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
- G. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- H. Accurately form components to suit landing and to each other and/or to building structure.
- I. Accommodate expansion and contraction of members and building movement without damage to connections or members.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that field conditions are acceptable and are ready to receive Work.



### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Clean and strip primed steel items to bare metal where Site welding is required.
- C. Supply items required to be cast into concrete with setting templates to appropriate Sections.

### 3.3 INSTALLATION, GENERAL

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure with anchors and base plates.
- C. Field-weld anchors as indicated on Shop Drawings. Touch up welds with primer. Grind welds smooth.
- D. Conceal bolts and screws whenever possible.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per story, noncumulative.
- C. Maximum Offset from Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

END OF SECTION



## SECTION 06 10 00

### ROUGH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Structural wall and roof framing.
  - 2. Built-up structural columns.
  - 3. Wall, and roof sheathing.
  - 4. Sill, gaskets flashings.
  - 5. Preservative treatment of wood.
  - 6. Fire-retardant treatment of wood.
  - 7. Miscellaneous framing and sheathing.
- B. Related Requirements:
  - 1. Section 06 17 53.00 - Shop fabricated wood trusses.

##### 1.2 REFERENCE STANDARDS

- A. American National Standards Institute / American Hardboard Association:
  - 1. ANSI/AHA A135.4 - Basic Hardboard.
- B. American Wood Protection Association:
  - 1. AWWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
  - 2. AWWPA U1 - Use Category System: User Specification for Treated Wood.
- C. APA - The Engineered Wood Association:
  - 1. APA - Plywood Design Specification, including supplements.
  - 2. APA AFG-01 - Adhesives for Field-Gluing Plywood to Wood Framing.
  - 3. APA PS 1 - Voluntary Product Standard - Structural Plywood.
- D. ASTM International:
  - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 3. ASTM C1177 - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
  - 4. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
  - 5. ASTM C1396 - Standard Specification for Gypsum Board.
  - 6. ASTM D2559 - Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
  - 7. ASTM D3498 - Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.



8. ASTM D5456 - Standard Specification for Evaluation of Structural Composite Lumber Products.
  9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  10. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  11. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- E. California Department of Health Care Services:
1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.
- F. Forest Stewardship Council:
1. FSC Guidelines.
- G. Green Seal:
1. GS-36 - Green Seal Standard for Adhesives for Commercial Use.
- H. National Lumber Grades Authority:
1. NLGA - Standard Grading Rules for Canadian Lumber.
- I. Northeastern Lumber Manufacturers Association:
1. NELMA - Standard Grading Rules for Northeastern Lumber.
- J. Redwood Inspection Service:
1. RIS - Standard Specifications for Grades of California Redwood Lumber.
- K. South Coast Air Quality Management District:
1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.
- L. Southern Pine Inspection Bureau:
1. SPIB - Standard Grading Rules for Southern Pine Lumber.
- M. U.S. Department of Commerce National Institute of Standards and Technology:
1. DOC PS 1 - Structural Plywood.
  2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
  3. DOC PS 20 - American Softwood Lumber Standard.
- N. West Coast Lumber Inspection Bureau:
1. WCLIB Standard 17 - Grading Rules for West Coast Lumber.
- O. Western Wood Products Association:
1. WWPA - Western Lumber Grading Rules.
- 1.3 COORDINATION
- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.





- B. Coordinate Work of this Section with installation of prefabricated wood trusses.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on insulated sheathing, wood preservative materials, and application instructions.
- C. Shop Drawings for Site-Fabricated Truss Frame: Indicate dimensions, wood species and grades, component profiles, drilled holes, fasteners, connectors, erection details, and sequence.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

#### 1.5 QUALITY ASSURANCE

- A. Perform Work according to:
  - 1. Lumber Grading Agency: Certified by DOC PS 20.
  - 2. Wood Structural Panel Grading Agency: Certified by APA - The Engineered Wood Association.
  - 3. Lumber: DOC PS 20.
  - 4. Wood Structural Panels: DOC PS 1 or PS 2.
- B. Surface-Burning Characteristics:
  - 1. Fire-Retardant-Treated Materials: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated material.
- D. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store materials according to manufacturer instructions.
- D. Protection:
  - 1. Protect trusses from warping or other distortion by stacking in vertical position and bracing to resist movement.
  - 2. Provide additional protection according to manufacturer instructions.



## PART 2 - PRODUCTS

### 2.1 FIREBLOCKING AND DRAFTSTOPPING

- A. Fireblocking:
  - 1. Solid Lumber:
    - a. Nominal Thickness: 2 inches.
  - 2. Structural Wood Panel:
    - a. Thickness: 23/32 inch.
    - b. Joints: Backed by structural wood panel.
- B. Draftstopping:
  - 1. Gypsum Board: 1/2 inch (13 mm) thick.

### 2.2 MATERIALS

- A. Lumber:
  - 1. Lumber Grading Rules: Comply with APA, WCLIB, or WWPA.
  - 2. Studding:
    - a. Species: Douglas Fir-Larch.
    - b. Grade: No. 2.
    - c. Maximum Moisture Content: 19 percent.
- B. Sheathing:
  - 1. Wood Structural Panel Roof Sheathing:
    - a. Description: APA Structural I plywood
    - b. Span Rating: 40/20.
    - c. Exposure Durability: Exterior.
    - d. Facing: Unsanded.
    - e. Faces: Water-repellent paper.
  - 2. Gypsum Wall Sheathing:
    - a. Comply with ASTM C1396 Type X fire resistant.
    - b. Thickness: 5/8 inch.
    - c. Sheet Size: 24 by 96 inches.
    - d. Edges: Square.
    - e. Faces: Water-repellent paper.

### 2.3 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWP A U1, Commodity Specifications A-Sawn Products or F-Wood Composites, using SBX preservative.
- B. Wood Preservative (Surface Application):
  - 1. Type: Clear.
- C. Moisture Content after Treatment: Kiln dried (KDAT):
  - 1. Lumber: Maximum 19 percent.



2. Structural Panels: Maximum 15 percent.

## 2.4 ACCESSORIES

### A. Fasteners and Anchors:

1. Fasteners:
  - a. High-Humidity and Treated Wood Locations: hot-dip galvanized steel.
  - b. Elsewhere: Unfinished steel.
2. Nails and Staples: Comply with ASTM F1667.
3. Drywall Screws:
  - a. Description: Bugle head, hardened steel, power-driven.
  - b. Length: To achieve full penetration of sheathing substrate.

### B. Structural Framing Connectors:

1. Material: Hot-dipped galvanized steel.
2. Size: To suit framing conditions.

### C. Sill Gasket on Top of Foundation Wall:

1. Material: Closed-cell polyethylene foam from continuous rolls.
2. Thickness: 1/4 inch.
3. Width: Plate width.

## PART 3 - EXECUTION

### 3.1 APPLICATION

#### A. Framing:

1. Select individual pieces such that knots and defects will not interfere with placement of bolts when nailing or making connections.
2. Discard defective pieces.
3. Set structural members level, plumb, and in correct position.
4. Fasten framing according to applicable code.
5. Make provisions for erection loads and for sufficient temporary bracing to maintain that structure is safe, plumb, and in alignment until completion of erection and installation of permanent bracing.
6. Place horizontal members crown side up.
7. Construct load-bearing framing members full length without splices.
8. Openings:
  - a. Space short studs over and under opening to stud spacing.
9. Headers:
  - a. Construct double-joist headers at floor openings, ceiling openings, and under-wall stud partitions parallel to floor joists.
  - b. Frame rigidly into joists.
10. Sill Gaskets:
  - a. Place directly on cementitious foundation.
  - b. Puncture gasket clean and fit tight to protruding foundation anchor bolts.



B. Sheathing:

1. Install gypsum sheathing according to ASTM C1280.
2. Fasten sheathing according to applicable code.
3. Secure roof sheathing with longer edge (strength axis) perpendicular to framing members, with ends staggered and sheet ends over bearing.
4. Fully engage tongue-and-groove edges.

C. Fireblocking and Draftstopping:

1. Install fireblocking to cut off concealed draft openings.
2. Concealed Framed Wall and Furred Spaces: Install fireblocking vertically at floor and ceiling levels and horizontally at maximum 10 feet o.c.
3. Install fireblocking between:
  - a. Vertical walls and partitions.
  - b. Horizontal floor and roof framing.
  - c. Soffits, dropped ceilings, cove ceilings, and other horizontal concealed spaces.
  - d. Stair Stringers: Furnish at top and bottom of each rung.
4. Exterior Combustible Architectural Trim: Install fireblocking at maximum 20 feet o.c.

D. Site-Applied Wood Treatment:

1. Brush-apply one coat of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings.
2. Treat Site-sawn cuts by applying preservative according to AWPAC M4.
3. Allow preservative to dry prior to erecting members.

### 3.2 TOLERANCES

A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.

B. Framing and Furring Members to Receive a Finished Wall or Ceiling: Align finish surface to vary not more than 1/8 inch from a theoretical plane or surface of the room or space.

C. Other Framing Members: Maximum 1/4 inch from indicated position.

END OF SECTION



## SECTION 06 10 53

### MISCELLANEOUS ROUGH CARPENTRY

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Roof curbs, cants, and perimeter nailers.
  - 2. Blocking in wall and roof openings.
  - 3. Wood furring and grounds.
  - 4. Concealed wood blocking for support of wall cabinets.
  - 5. Preservative treatment of wood.
- B. Related Requirements:
  - 1. Section 04 20 00.00 - Unit Masonry.
  - 2. Section 06 10 00.00 - Rough Carpentry.

##### 1.2 REFERENCE STANDARDS

- A. American National Standards Institute:
  - 1. ANSI A208.1 - Mat-Formed Wood Particleboard.
- B. American Wood Protection Association:
  - 1. AWP A M4 - Standard for the Care of Preservative-Treated Wood Products.
  - 2. AWP A U1 - Use Category System: User Specification for Treated Wood.
- C. ASTM International:
  - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 4. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. California Department of Health Services:
  - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers, including 2004 Addenda.
- E. Forest Stewardship Council:
  - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- F. The Redwood Inspection Service:
  - 1. RIS - Standard Specifications for Grades of California Redwood Lumber.



- G. Southern Pine Inspection Bureau:
  - 1. SPIB - Standard Grading Rules for Southern Pine Lumber.
- H. U.S. Department of Commerce National Institute of Standards and Technology:
  - 1. DOC PS 1 - Construction and Industrial Plywood.
  - 2. DOC PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
  - 3. DOC PS 20 - American Softwood Lumber Standard.
- I. West Coast Lumber Inspection Bureau:
  - 1. WCLIB - Standard Grading Rules for West Coast Lumber.
- J. Western Wood Products Association:
  - 1. WWPA 2011 Western Lumber Grade Rules, including supplements.

### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit technical data and application instructions on wood-preservative and fire-retardant treatment materials.

### 1.4 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's Certificate: Certify that the following products meet or exceed specified sustainable design requirements.
  - 1. Materials Resources Certificates:
    - a. Certify source for regional materials and distance from Project Site.
    - b. Certify lumber is harvested from Forest Stewardship Council Certified well-managed forest.
  - 2. Indoor Air Quality Certificates:
    - a. Certify each composite wood [and agrifiber] product contains no added urea formaldehyde resins.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  - 1. Provide cost data for the following products:
    - a. Regional products.
    - b. Certified wood products.

### 1.5 QUALITY ASSURANCE

- A. Perform Work according to following:
  - 1. Lumber Grading Agency: Certified by DOC PS 20.



2. Wood Structural Panel Grading Agency: Certified by APA - The Engineered Wood Association.
  3. Lumber: DOC PS 20.
  4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
- B. Surface-Burning Characteristics:
1. Fire-Retardant-Treated Materials: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated material.
- D. Maintain copy of each standard affecting the Work of this Section on-site.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Lumber Grading Rules: WCLIB or WWPA G-5.

### 2.2 FACTORY WOOD TREATMENT

- A. Wood Preservative (Pressure Treatment): AWP A U1, commodity specification A-sawn products or F-wood composites using ACQ preservative.
- B. Wood Preservative (Surface Application): Clear.
- C. Moisture Content after Treatment: Kiln dried KDAT.
1. Lumber: Maximum 19 percent.
  2. Structural Panels: Maximum 15 percent.

### 2.3 ACCESSORIES

- A. Fasteners and Anchors:
1. Fasteners: ASTM A153, hot-dip galvanized steel for high-humidity and treated wood locations, unfinished steel elsewhere.
  2. Nails and Staples: ASTM F1667.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that substrate conditions are ready to receive blocking, curbing, and framing.



### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Coordinate placement of blocking, curbing, and framing items.

### 3.3 INSTALLATION

- A. Set members level and plumb, in correct position.
- B. Place horizontal members, crown side up.
- C. Construct curb members of solid wood sections.
- D. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- E. Space framing and furring 16 inches o.c.
- F. Secure sheathing to framing members with ends over firm bearing and staggered.

### 3.4 SITE-APPLIED WOOD TREATMENT

- A. Brush-apply one coat of preservative treatment on wood in contact with cementitious materials or roofing and related metal flashings.
- B. Treat Site-sawn cuts. Apply preservative to Site-sawn cuts according to AWPA M4.
- C. Allow preservative to dry prior to erecting members.

END OF SECTION





## SECTION 06 17 53

### SHOP-FABRICATED WOOD TRUSSES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Shop-fabricated wood trusses for:
    - a. Floor framing.
    - b. Bridging, bracing, and anchorage.
  - 2. Preservative treatment of wood.
- B. Related Requirements:
  - 1. Section 06 10 00 - Rough Carpentry: Framing of openings between trusses.
  - 2. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking, plating, support members, framing for openings and framing of openings between trusses.

##### 1.2 REFERENCE STANDARDS

- A. American Wood Protection Association:
  - 1. AWWPA M4 - Standard for the Care of Preservative-Treated Wood Products.
  - 2. AWWPA U1 - Use Category System: User Specification for Treated Wood.
- B. APA - The Engineered Wood Association:
  - 1. APA/EWA Plywood Design Specification.
- C. ASTM International:
  - 1. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
  - 2. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
  - 3. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
  - 4. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
  - 5. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 6. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 7. ASTM F1667 - Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
- D. California Department of Public Health:
  - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers (includes Addendum 2004).



- E. Forest Stewardship Council:
  - 1. FSC Guidelines.
- F. National Particleboard Association:
  - 1. NPA A208.1 - Particleboard.
- G. Redwood Inspection Service:
  - 1. RIS - Standard Specifications for Grades of California Redwood Lumber.
- H. Southern Pine Inspection Bureau:
  - 1. SPIB - Standard Grading Rules for Southern Pine Lumber.
- I. Truss Plate Institute:
  - 1. TPI - Building Component Safety Information (BCSI): Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses.
  - 2. TPI DSB - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.
  - 3. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.
- J. U.S. Department of Commerce - National Institute of Standards and Technology:
  - 1. Voluntary Product Standard PS 1 - Structural Plywood.
  - 2. Voluntary Product Standard PS 2 - Performance Standard for Wood-Based Structural-Use Panels.
  - 3. Voluntary Product Standard PS 20 - American Softwood Lumber Standard.
- K. West Coast Lumber Inspection Bureau:
  - 1. WCLIB Standard 17 - Grading Rules for West Coast Lumber.
- L. Western Wood Products Association:
  - 1. WWPA G-5 - Western Lumber Grading Rules.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate placement of sheathing with Work of this Section.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit truss plate connections, bearing plates, anchor connections, wind uplift connections, bridging and bracing.
- C. Shop Drawings: Indicate truss sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, loads and truss cambers, framed openings.
- D. Design Calculations: Indicate design loads, truss reactions, and member forces, deflections, and stresses.



- E. Manufacturer's/Fabricator's Certificate: Certify that products meet or exceed specified requirements.
- F. Delegated Design Submittals: Submit signed and sealed Shop Drawings with design calculations and assumptions for sizes, dimensions, spacing of trusses, associated components, uplift connectors, web and chord sizes, plate sizes, design loads, truss cambers, framed openings.
- G. Source Quality-Control Submittals: Indicate results of shop tests and inspections.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer/fabricator, erector, and licensed professional.
  - 2. Submit manufacturer's/fabricator's approval of erector.

#### 1.5 SUSTAINABLE DESIGN SUBMITTALS

- A. Section 01 81 13 - Sustainable Design Requirements: Requirements for sustainable design submittals.
- B. Manufacturer's/Fabricator's Certificate: Certify products meet or exceed specified sustainable design requirements.
  - 1. Materials Resources Certificates:
    - a. Certify recycled material content for recycled content products.
    - b. Certify source for regional materials and distance from Project Site.
    - c. Certify that lumber is harvested from Forest Stewardship Council Certified well-managed forest.
  - 2. Indoor Air Quality Certificates:
    - a. Certify each composite wood product contains no added urea formaldehyde resins.
- C. Product Cost Data: Submit cost of products to verify compliance with Project sustainable design requirements. Exclude cost of labor and equipment to install products.
  - 1. Provide cost data for the following products:
    - a. Products with recycled material content.
    - b. Regional products.
    - c. Certified wood products.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work as follows:
  - 1. Lumber Grading: Certified by DOC PS 20.
  - 2. Plywood Grading Agency: Certified by APA/EWA.
  - 3. Lumber: Comply with DOC PS 20.
  - 4. Wood Structural Panels: DOC PS 1 or DOC PS 2.
- B. Truss Design, Fabrication, and Installation: Comply with TPI BSCI, TPI DSB, and TPI 1.



- C. Apply label from agency approved by authority having jurisdiction to identify each preservative-treated material.
- D. Maintain copy of each standard affecting Work of this Section on Site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer/Fabricator: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' experience.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed at Project location in State of Maine.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site and inspect for damage.
- C. Storage:
  - 1. Do not lay trusses flat.
  - 2. Store truss depth in vertical position resting on intermittent bearing pads.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  - 1. Verify field measurements prior to fabrication.
  - 2. Indicate field measurements on Shop Drawings.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design Roof Live and Dead Load: per drawings.

#### 2.2 MATERIALS

- A. Lumber Grading Rules: Comply with WCLIB, WWPA G-5.
- B. Wood Members:
  - 1. Single top and bottom chord.
  - 2. Moisture Content:
    - a. Maximum: 19 percent.
    - b. Minimum: 7 percent.
- C. Steel Plate Connectors:
  - 1. Comply with TPI 1, Section 6.
  - 2. Die stamped with integral teeth.



3. Finish: galvanized.

D. Truss Bridging: Type, size, and spacing as recommended by truss manufacturer/fabricator].

## 2.3 FABRICATION

A. Fabricate trusses to achieve specified structural requirements.

B. Fabricate top and bottom chord extensions as indicated on Drawings.

C. Fabricate to achieve minimum end bearing of:

1. 11 inches on steel.
2. 3 inches on masonry.

D. Frame special sized openings in web framing as indicated on Drawings.

## 2.4 WOOD TREATMENT

A. Wood Preservative by Pressure Treatment:

1. Comply with AWPA U1:
  - a. Commodity Specification A - Sawn Products.
2. Type: ACQ.

B. Wood Preservative by Surface Application:

1. Color: Clear.

C. Moisture Content:

1. Kiln dried (KDAT).
2. Lumber: Maximum 19 percent after treatment.
3. Structural Panels: Maximum 15 percent after treatment.

## 2.5 ACCESSORIES

A. Wood Blocking, Plating, Support Members, Framing for Openings:

1. As specified in Section 06 10 53 - Miscellaneous Rough Carpentry.

B. Fasteners and Anchors:

1. Material:
  - a. High Humidity and Treated Wood Locations: ASTM A153, hot dipped galvanized steel.
  - b. Elsewhere: Unfinished steel.
2. Nails and Staples: Comply with ASTM F1667.

## 2.6 SOURCE QUALITY CONTROL

A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.

B. Inspection: Inspect Work performed at manufacturer's/fabricator's facility to verify conformance to Contract Documents.



- C. Owner Inspection:
  - 1. Make completed trusses available for inspection at manufacturer's/fabricator's factory prior to packaging for shipment.
  - 2. Notify Owner at least seven days before inspection is allowed.
- D. Certificate of Compliance:
  - 1. If manufacturer/fabricator is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's/fabricator's facility conforms to Contract Documents.
  - 2. Specified shop tests are not required for Work performed by approved manufacturer/fabricator.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for erection examination.
- B. Verify that supports and openings are ready to receive trusses.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for erection preparation.
- B. Coordinate placement of bearing items.

### 3.3 ERECTION

- A. Set members level, plumb, and in correct position.
- B. Make provisions for erection loads and sufficient temporary bracing to maintain plumb and aligned structure until completion of erection and installation of permanent bracing.
- C. Do not field cut or alter structural members without approval of Architect/Engineer.
- D. Place headers and supports to frame openings.
- E. Frame openings between trusses with lumber as specified in Section 06 10 00 - Rough Carpentry and 06 10 53 - Miscellaneous Rough Carpentry.
- F. After erection, touch up damaged surfaces with primer consistent with shop coat.
- G. Site-Applied Wood Treatment:
  - 1. Brush-apply one coat of preservative treatment on wood in contact with cementitious materials or roofing and related metal flashings.
  - 2. Treat site-sawn cuts by applying preservative according to AWWA M4.
  - 3. Allow preservative to dry prior to erecting members.



### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Indicated Position:
  - 1. Framing Members: 1/2 inch.

END OF SECTION



## SECTION 07 01 50

### MAINTENANCE OF MEMBRANE ROOFING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Partial removal of existing roofing system in preparation for new roof membrane system.
- B. System Description:
  - 1. Indicated Roof Areas: Remove existing perimeter flashings, base flashings, counter flashings, vent stack flashings, roofing membrane, insulation, vapor retarder, sheathing, and damaged deck.
  - 2. Remove roof-mounted mechanical equipment.
- C. Related Requirements:
  - 1. Section 02 41 19 - Selective Structure Demolition: Minor demolition Work.
  - 2. Section 07 54 03 - Sheet Membrane Roofing - Fully Adhered: Single-sheet EPDM, PVC, neoprene, TPO, or other single- or composite-membrane roofing, fully bonded to substrate.
  - 3. Section 07 62 00 - Sheet Metal Flashing and Trim: Sheet metal Work, flashing, and trim associated with roofing and waterproofing membranes.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Remove only existing roofing materials being replaced with new materials on same day as weather will permit.
- C. Coordinate Work of this Section with affected mechanical and electrical Work associated with roof penetrations.

##### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.





## 1.5 SCHEDULING

- A. Section 01 30 00 - Administrative Requirements and 01 32 16 - Construction Progress Schedule: Requirements for scheduling.
- B. Schedule Work of this Section to coincide with commencement of installation of new roofing system.

## 1.6 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Qualifications Statement:
  - 1. Submit qualifications for materials removal firm.

## 1.7 QUALIFICATIONS

- A. Materials Removal Firm: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

## 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Do not remove existing roofing membrane if weather conditions threaten integrity of building contents or intended continued occupancy.
- C. Maintain continuous temporary protection prior to and during installation of new roofing system to maintain building weathertight.

# PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Temporary Protection:
  - 1. Sheet fiberglass-reinforced plastic.
  - 2. Furnish weights to retain sheeting in position.
- B. Protection Board:
  - 1. Description: Cellulose fiber board, with both faces finished with mineral fiber, asphalt, and kraft paper.
  - 2. Comply with ASTM C208, Type II.
  - 3. Size: 4 feet by 8 feet inches.
  - 4. Thickness: 5/8 inch.
  - 5. Thermal Conductivity: 0.36 Btu-in./h-ft.-deg. F at 75 degrees F.
  - 6. Board Edges: Square.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that existing roof surface is clear and ready for Work of this Section.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Sweep roof surface clean of loose matter.
- C. Remove loose refuse and dispose off Site.
- D. Existing Construction:
  - 1. Remove metal counter flashings.
  - 2. Remove relevant portions of roofing membrane, perimeter base flashings, and flashings around roof protrusions.
  - 3. Cut and lay flat membrane blisters.
  - 4. Remove relevant portions of insulation and fasteners, cant strips, and blocking.
  - 5. Remove damaged deck materials.
  - 6. Repair existing wood deck surface to provide smooth working surface for new roof system.

### 3.3 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Sheeting:
  - 1. Install temporary protective sheeting over uncovered deck surfaces.
  - 2. Turn sheeting up and over parapets and curbing.
  - 3. Retain sheeting in position with weights.
- C. Provide for surface drainage from sheeting to existing drainage facilities.
- D. Do not permit traffic over unprotected or repaired deck surface.

END OF SECTION



## SECTION 07 11 00

### DAMPPROOFING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Cold-applied asphalt dampproofing.
  - 2. Capillary breaks.
- B. Related Requirements:
  - 1. Section 07 21 13 - Board Insulation: Perimeter and horizontal insulation.
  - 2. Section 31 23 23 - Fill: Backfilling as required at building perimeter and Site structures.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM D41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
  - 2. ASTM D43 - Standard Specification for Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing.
  - 3. ASTM D449 - Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
  - 4. ASTM D450 - Standard Specification for Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.
  - 5. ASTM D1187 - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.  
ASTM D3747 - Standard Specification for Emulsified Asphalt Adhesive for Adhering Roof Insulation.  
ASTM D4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free.
  - 6. ASTM D5643 - Standard Specification for Coal Tar Roof Cement, Asbestos Free.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit properties of primer, bitumen, and mastics.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit special procedures and perimeter conditions requiring special attention.
- E. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and applicator.
  - 2. Submit manufacturer's approval of applicator.



#### 1.4 QUALITY ASSURANCE

- A. Perform Work according to Manufacturer standards.

#### 1.5 AMBIENT CONDITIONS

- A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.
- B. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturers. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.
- B. Capillary Break: Minimum 10-year warranty up to 10 PSI water resistance.

#### 2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. BASF.
  - 2. Henry.
  - 3. Karnak Corporation.
  - 4. W.R. Meadows, Inc.
- B. Trowel Coats: ASTM D 1227, Type II, Class 1 or Type IV.
  - 1. Available Products:
    - a. Sealmastic, Type 3; W.R. Meadows
    - b. 785 Asphalt Emulsion Sealer and Dampproofers; Henry
    - c. MasterSeal 614; BASF
    - d. Karnak 920 AF; Karnac Chemical Corp.
- C. Fibered Brush and Spray Coats: ASTM D 1277, Type II, Class 1 or Type IV.
  - 1. Available Products:
    - a. Sealmastic, Type 2; W.R. Meadows
    - b. 789 Fibered Asphalt Emulsion Sealer and Dampproofers; Henry
    - c. MasterSeal 615; BASF
    - d. Karnak 220 AF; Karnac Chemical Corp.



- D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
  - 1. Available Products:
    - a. Sealmastic, Type 1; W.R. Meadows
    - b. 107 Asphalt Emulsion Sealer and Dampproofers; Henry
    - c. MasterSeal 610; BASF
    - d. Karnak 100 AF; Karnac Chemical Corp.

## 2.4 CAPILLARY BREAK MATERIALS

- A. Water-based, waterproofing paint designed to provide a waterproof barrier on concrete or masonry surfaces.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Rust-Oleum-Zinsser: WaterTile Mold & Mildew-Proof Waterproofing Paint.
  - 2. Sealkrete: Damplock.
  - 3. UGL; Drylok Latex Masonry Waterproofers.
- C. Performance: Product shall provide a minimum of 10 years protection against 10 PSI water pressure.

## 2.5 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
- B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.
- C. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.
- D. Patching Compound: Epoxy or latex-modified repair mortar or Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

## 2.6 INSULATION

Insulation, General: Comply with Section 072100.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that substrate surfaces are durable and free of matter detrimental to adhesion or application of dampproofing system.
- C. Verify that items penetrating surfaces to receive dampproofing are securely installed.



### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Clean, prepare and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for surfaces to receive dampproofing.
- C. Apply mastic to seal penetrations, small cracks, or minor honeycombs in substrate.
- D. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.
- E. Clean substrates of projections and substances detrimental to dampproofing work, fill voids, seal joints, and remove bond breakers if any.
- F. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

### 3.3 APPLICATION

- A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and dry time before backfilling unless otherwise indicated.
  - 1. Apply dampproofing to provide continuous plane of protection.
  - 2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.
- B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches over outside face of footing.
  - 1. Extend dampproofing 12 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
  - 2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coats for embedding fabric is in addition to other coats required.
- C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least ¼ inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
  - 1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.
  - 2. Lap dampproofing at least ¼ inch onto shelf angles supporting veneer.

### 3.4 COLD -APPLIED, EMULSIFIED-ASHALT DAMPPROOFING

- A. On Concrete Foundation Wall: Two coatings of asphalt dampproofing.



- B. Subgrade Tunnel: Patch existing coal-tar dampproofing with two coatings of new coal-tar dampproofing at disturbed areas.
- C. Cavity Wall: Two coats of asphalt dampproofing on exterior face of inner wythe of concrete masonry units.

### 3.5 CAPILLIARY BREAK INSTALLATION

- A. Apply in two coats in accordance with manufacturer's instructions.
- B. Apply to the top of concrete foundation walls and down the inside and outside 2 to 3 inches.

END OF SECTION



## SECTION 07 21 13

### BOARD INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Rigid and semi-rigid board insulation in cavity wall construction.
- B. Related Requirements:
  - 1. Section 07 26 00 - Vapor Retarders: Vapor retarder materials for adjacent insulation.
  - 2. Section 07 54 03 - Sheet Membrane Roofing – Fully Adhered: Rigid insulation at roof system.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - 2. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
  - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 4. ASTM E970 - Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.
- B. California Department of Health Care Services:
  - 1. CA/DHS/EHLB/R-174 - Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.
- C. South Coast Air Quality Management District:
  - 1. SCAQMD Rule 1168 - Adhesive and Sealant Applications.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Section 07 26 00 - Vapor Retarders for installation of vapor retarder and Section for air seal materials.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information on product characteristics, performance criteria, limitations, and adhesives.





- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

#### 1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics of Insulation Installed in Concealed Locations:
  - 1. Foam Plastic Insulation: Maximum 75/450 flame-spread/smoke-developed index when tested according to ASTM E84.
  - 2. Other Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- B. Surface Burning Characteristics of Insulation Installed in Exposed Locations:
  - 1. Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- C. Apply label from agency approved by authority having jurisdiction to identify each foam plastic insulation board.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Remove insulation that becomes wet or damp.
  - 3. Provide additional protection according to manufacturer instructions.

#### 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.



- B. Minimum Conditions: Do not install adhesives when temperature or weather conditions are detrimental to successful installation.

## PART 2 - PRODUCTS

### 2.1 BOARD INSULATION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. DiversiFoam Products.
  - 2. Down Chemical Company (The)
  - 3. Owens Corning
  - 4. Pactiv Building Products
- B. Substitutions: As specified in Section 01 60 00 - Product Requirements.

### 2.2 MATERIALS

- A. Extruded Polystyrene Insulation:
  - 1. Type: Cellular.
  - 2. Comply with ASTM C578, Type IV.
  - 3. Board Density: 1.55 pcf.
  - 4. Board Size: 4 feet by 8 feet.
  - 5. Board Thickness: 1.5 inch.
  - 6. Thermal Resistance: R-value of 7.5 h-sq. ft.-degree F/Btu.
  - 7. Water Absorption:
    - a. Comply with ASTM D2842.
    - b. Maximum: 0.1 percent by volume.
  - 8. Minimum Compressive Strength: 25 psi.
  - 9. Board Edges: Square.

### 2.3 ACCESSORIES

- A. Adhesive Type 1: Type as recommended by insulation manufacturer for application.
- B. Tape:
  - 1. Material: Bright aluminum.
  - 2. Type: Self-adhering , mesh reinforced.
  - 3. Width: 2 inches.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.



- B. Verify that substrate, adjacent materials, and insulation boards are dry and ready to receive insulation and adhesive.
- C. Verify that substrate surface is flat, free of honeycomb, fins, irregularities, and materials or substances affecting adhesive bond.

### 3.2 INSTALLATION

- A. Foundation Perimeter:
  - 1. Polyethylene Sheeting:
    - a. Adhere 4-inch-wide strip of polyethylene sheet over construction joints, with double beads of Type 1 adhesive on each side of joint.
    - b. Tape to seal joints.
    - c. Extend sheet full height of joint.
  - 2. Apply Type 1 adhesive to full bed 1/8 inch thick.
  - 3. Foundation Wall:
    - a. Install boards on foundation wall perimeter, horizontally.
    - b. Place boards in method to maximize contact bedding.
    - c. Stagger end joints and butt edges and ends tight to protrusions and adjacent board.
  - 4. Extend boards over control joints, unbonded to foundation and 4 inches on one side of joint.
  - 5. Cut and fit insulation tight to protrusions or interruptions to insulation plane.
- B. Under Concrete Slabs:
  - 1. Place insulation under slabs-on-grade after base for slab has been compacted.
  - 2. Cut and fit insulation tight to protrusions or interruptions to insulation plane.
  - 3. Prevent insulation from being displaced or damaged while placing vapor retarder and slab.

END OF SECTION



## SECTION 07 21 14

### CAVITY WALL INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Provide rigid insulation board at cavity walls.

##### 1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data and installation instructions for each material and product used.

##### 1.3 QUALITY ASSURANCE

- A. Comply with governing codes and regulations. Provide products of acceptable manufacturers which have been in satisfactory use in similar service for three years. Use experienced installers. Deliver, handle, and store materials in accordance with manufacturer's instructions.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type X, 1.35 cu.ft. density, with maximum flame-spread and smoke-developed indices of 75 and 450, respectively:
  - 1. Manufacturer: Styrofoam Cavitymate by Dow Chemical.
  - 2. Compressive Strength, ASTM D 1621: 15 pounds per square inch, minimum.
  - 3. Dimensions: 4ft. by 8 ft.
  - 4. Thickness: 2-1/2 inches.
  - 5. Board Edge: Shiplap.

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

- A. Install materials and systems in accordance with manufacturer's instructions and approved submittals. Install materials and systems in proper relation with adjacent construction.
- B. Coordinate with work of other sections. Provide full thickness in one layer over entire area, tightly fitting around penetrations.
- C. Protect installed insulation until covered.

END OF SECTION



## SECTION 07 21 16

### BLANKET INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Batt insulation and vapor retarder in exterior wall and ceiling construction.
  - 2. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior walls and roofs.
- B. Related Requirements:
  - 1. Section 07 21 13 - Board Insulation: Boards of polystyrene, polyurethane, or polyisocyanurate foam, cellular glass, or rigid or semi-rigid glass fiber.
  - 2. Section 07 26 00 - Vapor Retarders: Vapor retarder materials adjacent to insulation.
  - 3. Section 07 84 00 - Firestopping: Products for closing openings in and penetrations through fire-rated construction.
  - 4. Section 09 21 16 - Gypsum Board Assemblies : Acoustic insulation.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - 2. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 3. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
  - 4. ASTM E970 - Standard Test Method for Critical Radiant Flux of Exposed Attic Floor Insulation Using a Radiant Heat Energy Source.

##### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with Section 072600 - Vapor Retarders for installation of vapor retarder.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer data on product characteristics, performance criteria, limitations.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.



- D. Manufacturer Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- E. Qualifications Statement:
  - 1. Submit qualifications for manufacturer.

## 1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics of Insulation Installed in Concealed Locations:
  - 1. Batt Insulation: Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- B. Surface Burning Characteristics of Insulation Installed in Exposed Locations:
  - 1. Maximum 25/450 flame-spread/smoke-developed index when tested according to ASTM E84.
  - 2. Attic Floor Insulation: Minimum 0.038 Btu/sq. ft.-h critical radiant flux when tested according to ASTM E970.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Store according to manufacturer instructions.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Remove insulation that becomes wet or damp.
  - 3. Provide additional protection according to manufacturer instructions.

## PART 2 - PRODUCTS

### 2.1 SYSTEM DESCRIPTION

- A. Continuity of Thermal Barrier at Building Enclosure Elements: In conjunction with thermal insulating materials as specified in Section 042723 Cavity Wall Unit Masonry.
- B. Thermal Protection of Vapor Retarder in Conjunction with Vapor Retarder Materials: As specified in Section 072600 - Vapor Retarders.



## 2.2 BATT INSULATION

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. ROXUL Inc.
  - 2. Johns Manville, a Berkshire Hathaway Company.
  - 3. Owens Corning.
- B. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- C. Performance and Design Criteria:
- D. Vapor Retarder Permeance: Maximum 1 perm when tested according to ASTM E96, desiccant method.

## 2.3 MATERIALS

- A. Batt Insulation:
  - 1. Description: Preformed mineral-fiber batts, rolls, and blankets, with friction fit.
  - 2. Comply with ASTM C665, Type I.
  - 3. Thermal Resistance: R-value of 14 h-sq. ft.-degree F/Btu.
  - 4. Batt Size: 3.5 inches, by 16 inches, by 5 feet.
- B. Sheet Vapor Retarder:
  - 1. Description: Black polyethylene film for above-grade applications.
  - 2. Thickness: 6 mils.
- C. Staples:
  - 1. Material: Steel wire, galvanized.
  - 2. Type and Size: To suit application.
- D. Tape:
  - 1. Material: Polyethylene.
  - 2. Type: Self-adhering, mesh reinforced.
  - 3. Width: 2 inches.
- E. Insulation Fasteners:
  - 1. Description: Steel impaling spindle and clip on flat metal base.
  - 2. Backing: Self-adhering.
  - 3. Length: To suit insulation thickness.
  - 4. Capable of securely and rigidly fastening insulation in place.
- F. Wire Mesh: Galvanized steel, hexagonal wire mesh.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that substrate, adjacent materials, and insulation are dry and ready to receive insulation.

### 3.2 INSTALLATION

- A. Install in exterior wall spaces without gaps or voids.
- B. Do not compress insulation.
- C. Trim insulation neatly to fit spaces.
- D. Insulate miscellaneous gaps and voids.
- E. Fit insulation tight in spaces and tight to exterior side of mechanical and electrical services within plane of insulation.
- F. Vapor Retarder:
  - 1. Install insulation with factory-applied vapor retarder membrane facing warm side of building spaces.
  - 2. Lap ends and side flanges of membrane over framing members.
  - 3. Tape in place.
- G. Tape-seal butt ends, lapped flanges, and tears or cuts in membrane.
- H. Wood Framing:
  - 1. Place vapor retarder on warm side of insulation by stapling at 6 inches (150 mm) o.c.
  - 2. Lap and seal sheet retarder joints over member face.
- I. Attachment:
  - 1. Retain insulation in place with wire mesh secured to framing members.
  - 2. Tape-seal tears or cuts in vapor retarder.
- J. Extend vapor retarder tight to full perimeter of adjacent window and door frames and to other items interrupting plane of membrane and tape-seal in place.

END OF SECTION





## SECTION 07 27 00

### AIR BARRIER MEMBRANES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Provide air barrier membranes at exterior wall assemblies and at locations required by code:

##### 1.2 PERFORMANCE REQUIREMENTS

- A. Commonwealth of Massachusetts Building Code Requirements: The intent of this specification is to require compliance with 780 CMR 13, including Section 1304.3, Air Leakage.
- B. Code 780 CMR 1304.3.1, Air Barriers: The building envelope shall be designed and constructed with a continuous air barrier to control air leakage into, or out of the conditioned space. An air barrier shall also be provided for interior partitions between conditioned space and space designed to maintain temperature or humidity levels which differ from those in the conditioned space by more than 50 percent of the difference between the conditioned space and design ambient conditions. The air barrier shall have the following characteristics:
  - 1. It must be continuous, with all joints made air-tight.
  - 2. It shall have an air permeability not to exceed 0.004 cubic feet per minute per square foot under a pressure differential of 0.3 in. water.
  - 3. It shall be capable of withstanding positive and negative combined design wind, fan and stack pressures on the envelope without damage or displacement, and shall transfer the load to the structure. It shall not displace adjacent materials under full load.
  - 4. It shall be durable or maintainable.
  - 5. The air barrier shall be joined in an air-tight and flexible manner to the air barrier material of adjacent systems, allowing for the relative movement of systems due to thermal and moisture variations and creep. Connection shall be made between:
    - a. Foundation and walls.
    - b. Walls and windows or doors.
    - c. Different wall systems.
    - d. Wall and roof.
    - e. Wall and roof over unconditioned space.
    - f. Walls, floor and roof across construction, control and expansion joints.
    - g. Walls, floors and roof to utility, pipe and duct penetrations.
- C. Code 780 CMR 1304.3.2, Air Barrier Penetrations: All penetrations of the air barrier and paths of air infiltration/exfiltration shall be made air-tight.
- D. Design Intent: Air barrier membrane shall be located, constructed and flashed to perform as an air and water barrier to discharge to the outside any incidental condensation or water penetration. Air barrier membrane shall accommodate movements of building materials by providing expansion and control joints as required, with



appropriate air seal materials at such locations, changes in substrate and perimeter conditions.

### 1.3 SUBMITTALS

- A. **Product Data:** Submit manufacturer's product data for each material. Include standard details, certified test results, installation instructions, and recommendations for sealing penetrations and perimeter.
- B. **Samples:** Submit three labeled samples of each product, not less than 6 by 12 inches in size.
- C. **Shop Drawings for Air Barrier Membrane Mockup:** Submit shop drawings for mockup indicating size of mockup, details of construction, and expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. Obtain approval of shop drawings prior to construction of mockup. Revise to show changes necessary to obtain approval of mockup.
- D. **Shop Drawings:** Submit shop drawings indicating details of construction, including expansion and control joints. Include relationship with adjacent materials, sequence of installation and materials and methods for sealing penetrations. At a minimum, shop drawings shall include details of the following connections, as applicable to the project:
  - 1. Foundation and walls.
  - 2. Walls and windows or doors.
  - 3. Different wall systems.
  - 4. Wall and roof.
  - 5. Wall and roof over unconditioned space.
  - 6. Walls, floor and roof across construction, control and expansion joints.
  - 7. Walls, floors and roof to utility, pipe and duct penetrations.
- E. **Qualifications of Installer:** Submit qualifications of firm installing air barrier membrane materials, including name and qualifications of supervisor for this project, and including name and location of three projects where similar work was performed by both firm and supervisor.
- F. **Mockups of Air Barrier Membrane Installation:** Prior to installation on the building, construct mockup of typical exterior wall assembly, including connection between wall and roof, and connection between wall and glazing to indicate relationship of materials with air barrier and quality of workmanship. Mockup shall use actual air barrier membrane, wall, window and roof materials. Provide several mockups if necessary to include the various conditions. Remove mockup assemblies from site at completion of project. Rebuild mockups which are not approved at no additional cost to the Owner.
  - 1. Construct mockup in accordance with details of mockup indicated on the Drawings.

### 1.4 PROJECT MEETINGS

- A. **Pre-Construction Meeting:** After approval of mockup shop drawings, but prior to construction of mock-up, convene a meeting with representatives of materials to be incorporated in the mockup and installers of mockup. Agenda shall include sequence and



details of construction to ensure continuity of air barrier.

- B. Pre-Installation Meeting: Convene a pre-installation meeting a minimum of one week prior to commencing work of this section. Attendees shall include representatives of air barrier manufacturer, exterior wall installers and project superintendent. Agenda shall include the following:
  - 1. Review of approved submittals.
  - 2. Review of mock-ups.
  - 3. Coordination with sequence of installation with adjacent materials.
  - 4. Schedule for subsequent work covering air barrier.
  - 5. Procedures for quality assurance.

## PART 2 - PRODUCTS

### 2.1 LIQUID AIR BARRIER MEMBRANE

- A. Liquid Air Barrier Membrane: Water-based asphalt emulsion modified with a blend of synthetic rubbers and special additives, compatible with sheet membranes. Provide one of the following:
  - 1. Roller Grade: BARRISEAL-R by Carlisle Coatings and Waterproofing, Inc.
  - 2. Spray Grade: BARRISEAL-S by Carlisle Coatings and Waterproofing, Inc.

### 2.2 SELF-ADHERING AIR BARRIER MEMBRANES

- A. Self-Adhering Air and Vapor Barrier Membrane: Self-adhering, self-sealing and self-healing rubberized asphalt integrally bonded to polyethylene film, nominal 40 mil thickness overall. Provide compatible membrane joint tape recommended by manufacturer. Provide manufacturer's recommended primer and one of the following which meet or exceed specified requirements.
  - 1. CCW-705 Membrane by Carlisle Coatings and Waterproofing, Inc.
- B. Transition Materials: To provide an air barrier between the membrane and adjacent materials, provide transition materials consisting of extruded low-modulus silicone sheet and silicone sealant designed to adhere to polyethylene side of membrane and adjacent material. Provide the following materials as acceptable to the manufacturer of the air barrier membrane:
  - 1. Cleaning Agent: Toluene.
  - 2. Silicone Sheet: SIL-SPAN Preformed Silicone Profiles by Pecora or ULTRASPAN Weatherstripping by General Electric. Provide preformed corners.
  - 3. Silicone Sealant: Dow 790 Silicone Sealant or Pecora 864 Silicone Sealant.

## PART 3 - EXECUTION

### 4.1 PREPARATION

- A. Clean substrate surfaces to receive air barrier membrane in accordance with manufacturer's instructions. Apply primer if recommended by manufacturer.



## 4.2 INSTALLATION

- A. Strictly comply with air barrier membrane manufacturer's printed instructions, approved submittals and the following:
  - 1. Apply materials within manufacturer's requirements for temperature and weather conditions.
  - 2. Do not apply to wet or frozen substrates.
  - 3. Do not allow contamination with dust or dirt.
  - 4. Seal completely at edges, perimeter and penetrations.
- B. Protect installed work from damage due to harmful weather exposures, physical abuse, and other causes.
- C. Provide temporary protection over air barrier membrane if materials covering air barrier membrane will not be installed within manufacturer's recommended time limit for exposure.
- D. Repair damage to air barrier membrane caused by construction activities or subsequent work prior to covering.

END OF SECTION



## SECTION 07 46 46

### FIBER-CEMENT SIDING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Fiber-cement siding for walls, soffits, and fascia.
  - 2. Related trim, flashings, accessories, and fastenings.
- B. Related Requirements:
  - 1. Section 06 10 00 - Rough Carpentry: Sheathing paper.
  - 2. Section 07 90 00 - Joint Protection: Sealant at perimeter, openings, and dissimilar materials.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets.

##### 1.3 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

##### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data indicating materials, component profiles, fastening methods, jointing details, sizes, surface texture, finish, color, and accessories.
- C. Samples: Submit two samples, 12 by 12 inch in size, illustrating surface texture, finish, and color.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and installer.
  - 2. Submit manufacturer's approval of installer.



## 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for closeout procedures.
- B. Maintenance Data: Submit manufacturer's information related to care and cleaning of fiber-cement siding.

## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials: Furnish 5% of installed area for each type of fiber-cement siding installed .

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Inspection: Accept siding materials on-Site. Inspect for damage.
- D. Store siding materials according to manufacturer's instructions.

## 1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

## 1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for fiber-cement siding.



## PART 2 - PRODUCTS

### 2.1 FIBER-CEMENT SIDING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. James Hardie Building Products – Hardie Panel Vertical Siding.
  - 2. CertainTeed Corporation.
  - 3. GAF.
- B. Substitutions: Section 01 60 00 - Product Requirements.
- C. Description: Furnish fiber-cement siding and accessories.

### 2.2 MATERIALS

- A. Fiber-Cement Siding:
  - 1. Comply with ASTM C1186, Grade II, Type A.
  - 2. Fiber-reinforced cement composite board for exterior use.
  - 3. Minimum Thickness: 5/16 inch.
  - 4. Width: 48 inch.

### 2.3 FINISHES

- A. Coating:
  - 1. Factory primed.

### 2.4 ACCESSORIES

- A. Nails, Staples, and Screws: Hot-dip galvanized type; nonstaining, of size and strength to securely and rigidly retain Work; prefinished to match siding finish.
- B. Flashings:
  - 1. 26-gage metal, to match siding.
- C. Accessory Components: Vented soffits, nonvented soffits, soffit vents, fascias, starter strips, trim, and corner boards; of same material and finish as siding.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that framing, substrate surfaces, and wall openings are ready to receive Work.



### 3.2 INSTALLATION

- A. Install fiber-cement siding according to manufacturer's instructions.
- B. Install flashings at internal and external corners sills head of wall openings and horizontal joints of sheet materials.
- C. Install corner strips, closures, and trim.
- D. Install sealant to prevent weather penetration.
- E. Touch up damaged prefinished surfaces.

### 3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 1/4 inch per 10 feet.
- C. Maximum Offset from Joint Alignment: 1/16 inch.

END OF SECTION





## SECTION 07 54 03

### SHEET MEMBRANE ROOFING - FULLY ADHERED

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. vapor retarder.
  - 2. Insulation.
  - 3. Base flashings.
  - 4. Cant strips.
  - 5. Sheet membrane roofing.
  - 6. Counterflashings.
- B. Related Requirements:
  - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood nailers and cant strips.
  - 2. Section 07 01 50 - Maintenance of Membrane Roofing: Requirements for re-roofing.
  - 3. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashing.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
  - 2. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
  - 3. ASTM C1371 - Standard Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers.
  - 4. ASTM C1549 - Standard Test Method for Determination of Solar Reflectance Near Ambient Temperature Using a Portable Solar Reflectometer.
  - 5. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
  - 6. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
  - 7. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
  - 8. ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
  - 9. ASTM D1004 - Standard Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting.
  - 10. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
  - 11. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.



12. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
13. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings.
14. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
15. ASTM E408 - Standard Test Methods for Total Normal Emittance of Surfaces Using Inspection-Meter Techniques.
16. ASTM E903 - Standard Test Method for Solar Absorptance, Reflectance, and Transmittance of Materials Using Integrating Spheres.
17. ASTM E1918 - Standard Test Method for Measuring Solar Reflectance of Horizontal and Low-Sloped Surfaces in the Field.
18. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces.

B. National Roofing Contractors Association:

1. NRCA - The NRCA Roofing and Waterproofing Manual.

C. Single Ply Roofing Institute:

1. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems.

D. UL:

1. UL - Fire Resistance Directory.
2. UL 790 - Standard Test Methods for Fire Tests of Roof Coverings.
3. UL 1256 - Fire Test of Roof Deck Constructions.
4. UL 1897 - Uplift Tests for Roof Covering Systems.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with installation of associated roof penetrations and metal flashings.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.
- C. Review preparation and installation procedures and coordinating and scheduling of related Work.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit characteristics of membrane materials, adhesives, seaming materials, flashing materials, insulation, and vapor retarders.



- C. Shop Drawings:
  - 1. Indicate setting plan for tapered insulation, joint and termination detail conditions, and conditions of interface with other materials.
  - 2. Indicate membrane layout and seam locations.
- D. Samples: Submit two, 12 by 12 inches, illustrating insulation and roofing membrane.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's Instructions: Submit special precautions required for seaming membrane.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- H. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and applicator.
  - 2. Submit manufacturer's approval of applicator.

#### 1.6 QUALITY ASSURANCE

- A. Perform Work according to NRCA Roofing and Waterproofing Manual.
- B. Roof Assembly Fire Classification:
  - 1. Minimum Class C when tested according to ASTM E108 or UL 790.
  - 2. Roof Assembly with Foam Insulation: Pass UL 1256.
- C. Surface-Burning Characteristics:
  - 1. Foam Insulation: Maximum 75/450 flame-spread/smoke-developed index when tested according to ASTM E84.
- D. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.
- E. Manufacturer's Inspection:
  - 1. Furnish manufacturer services before start of Work of this Section to verify substrate acceptability and review installation procedures and completed Work, such that specified warranty can be issued.
  - 2. Promptly and satisfactorily repair unsatisfactory conditions disclosed by manufacturer's Site visits.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' experience.
- B. Applicator: Company specializing in performing Work of this Section with minimum five years' experience and approved by manufacturer.



## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Deliver products in manufacturer's original containers, dry, undamaged, and with seals and labels intact.
- D. Store products in weather protected environment, clear of ground and moisture.
- E. Protect foam insulation from direct exposure to sunlight.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Do not apply roofing membrane during inclement weather or ambient temperatures below 40 degrees F or above 90 degrees F without proper weather protection.
- C. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

## 1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish 20-year manufacturer's warranty, including coverage of materials and installation and of resulting damage to building resulting from failure to resist penetration of moisture.

# PART 2 - PRODUCTS

## 2.1 DESCRIPTION

- A. Sheet Membrane Roofing System: One-ply sheet membrane system with sheathing, vapor retarder, insulation, and adhesive-applied membrane.

## 2.2 PERFORMANCE AND DESIGN CRITERIA

- A. Low-Slope Membrane Roof Edge Securement: Conform to SPRI ES-1 for wind speeds determined from applicable code.



- B. Uplift Resistance:
  - 1. Uplift Pressure Resistance: 90 psf.
  - 2. Comply with UL 1897.
- C. Vapor Retarder Permeance: Maximum one perm when tested according to ASTM E96, desiccant method.

### 2.3 SINGLE PLY ROOFING - FULLY ADHERED

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Carlisle SynTec Incorporated.
  - 2. Firestone Building Products Company.
  - 3. GAF Inc.
- B. Substitutions: Section 01 60 00 - Product Requirements.
- C. Sheet Vapor Retarder:
  - 1. Fire Resistance:
    - a. Fire resistant.
    - b. Comply with UL requirements.
  - 2. Materials: Plastic sheet.
  - 3. Adhesive: Fire retardant.
- D. Insulation:
  - 1. Polyisocyanurate:
    - a. Comply with ASTM C1289, Type II, Class 4.
    - b. Provide coated polymer-bonded glass-fiber mat faces on both major surfaces.
    - c. Board Size: 4 by 8 feet.
    - d. Board Thickness: 1/2 inch.
    - e. R-value: 2.5 per 1/2 inch of thickness.
    - f. Minimum Compressive Strength (Grade): 110 psi.
    - g. Board Edges: Square.
- E. Flexible Flashings:
  - 1. Material: Same as membrane.
  - 2. Thickness: 60 mil.
  - 3. Maximum Permeance Rate: 0.10.
  - 4. Tensile Strength: 1,200 psi.
  - 5. Elasticity: 50 percent with full recovery without set.
  - 6. Color: Black.
- F. Membrane:
  - 1. Material:
    - a. EPDM Rubber: Comply with ASTM D4637, Type II.
  - 2. Basis-of-Design Product: Sure-Tough by Carlisle SynTec Inc.
  - 3. Reinforcement: Reinforced.



4. Roll Size: .060 inch thick by 10 feet wide.
5. Color: black.
6. Tensile Strength:
  - a. 140 lbf.
  - b. Comply with ASTM D412.
7. Elongation:
  - a. 480%
  - b. Comply with ASTM D412.
8. Tear Strength:
  - a. 70 lbf.
  - b. Comply with ASTM D751.
9. Water Absorption:
  - a. +5.5
  - b. Comply with ASTM D471.
10. Water Vapor Permeance:
  - a. 0.10 perms.
  - b. Comply with ASTM E96 desiccant method.
11. Low-Temperature Brittleness:
  - a. -49 degrees F.
  - b. Comply with ASTM D2137.

G. Seaming Materials: As recommended by membrane manufacturer.

H. Adhesive Materials:

1. Surface Conditioner:
  - a. Compatible with membrane.
2. Membrane Adhesives: As recommended by membrane manufacturer.
3. Insulation Adhesive: As recommended by insulation manufacturer.
4. Thinner and Cleaner:
  - a. As recommended by adhesive manufacturer.
  - b. Compatible with sheet membrane.

I. Counterflashings: galvanized metal, as specified in Section 07 62 00 - Sheet Metal Flashing and Trim.

J. Control or Expansion Joint Flashing:

1. Flashing: Sheet butyl.
2. Counterflashings: Metal.
3. According to NRCA Construction Details.

## 2.4 ACCESSORIES

A. Wood Cant Strips:

1. As specified in Section 06 10 53 - Miscellaneous Rough Carpentry.
2. Pressure Preservative treated.

B. Sheathing Joint Tape:

1. Type: Heat resistant.



2. Width: 6 inches.
  3. Self-adhering.
- C. Insulation Joint Tape:
1. Description: Asphalt treated; glass-fiber reinforced.
  2. Width: 6 inches.
  3. Self-adhering.
- D. Roofing Nails:
1. Type: Galvanized, hot dipped, or non-ferrous type.
  2. Size and Configuration: As required to suit application.
- E. Insulation Fasteners:
1. Appropriate for purpose intended.
  2. Approved by system manufacturer.
  3. Length: As required for thickness of material plus metal washers.
- F. Sealants: As recommended by membrane manufacturer.
- G. Strip Reglet Devices:
1. Material: Galvanized steel.
  2. Maximum possible lengths per location.
  3. Furnish attachment flanges.
- H. Stack Boots: Flexible boot and collar for pipe stacks through membrane.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that surfaces and Site conditions are ready to receive Work.
- C. Verify that deck is supported and secure.
- D. Verify that deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valleys, or eaves, and suitable for installation of roof system.
- E. Verify that substrate is acceptable to membrane manufacturer.
- F. Verify that deck surfaces are dry and free of snow or ice.
- G. Confirm dry deck by moisture meter with moisture content acceptable to roofing manufacturer.
- H. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents are solidly set and that wood cant strips, wood nailing strips, and reglets are in place.



### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Wood Deck:
  - 1. Verify that wood decking joints are flat and tight.
  - 2. Seal decking joints with tape.
  - 3. Fill knot holes with latex filler.

### 3.3 APPLICATION

- A. Vapor Retarder:
  - 1. Apply vapor retarder to deck surface with adhesive.
  - 2. Extend vapor retarder under cant strips and blocking to deck edge.
  - 3. Vapor Barrier Seal:
    - a. Lap flexible flashing over vapor barrier of wall construction to provide continuity of vapor barrier seal.
    - b. Coordinate Work with Section 07 26 00 - Vapor Retarders.
- B. Insulation Application:
  - 1. Ensure that vapor retarder is clean and dry.
  - 2. Apply adhesive to deck and embed insulation into adhesive with full contact.
  - 3. Apply adhesive to top surface of insulation.
  - 4. Embed second layer of insulation into adhesive, with joints staggered minimum 6 inches from joints of first layer.
  - 5. Place constant thickness first layer and tapered thickness insulation second layer to required slope pattern.
  - 6. Minimum Total Insulation Thickness: As required to achieve insulation R-value of 30ci.
  - 7. Lay boards with edges in moderate contact without forcing.
  - 8. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
  - 9. Lay tapered boards for distance of 18 inches back from roof drains for positive drainage.
  - 10. Apply no more insulation than can be covered with membrane in same day.
  - 11. Tape insulation joints.
- C. Membrane Application:
  - 1. Apply primer.
  - 2. Install according to manufacturer's printed instructions.
  - 3. Apply adhesive as recommended by manufacturer.
  - 4. Roll out membrane, free from air pockets, wrinkles, or tears, and firmly press sheet into place without stretching.
  - 5. Bond sheet to substrate, except those areas directly over or within 3 inches of control or expansion joint.
  - 6. Sealing:
    - a. Overlap edges and ends and seal by contact tape, minimum 3 inches.





- b. Seal to make membrane permanently waterproof.
- c. Apply uniform bead of sealant to joint edge.
- 7. Apply joint tape and seal.
- 8. Extend membrane up cant strips minimum of 6 inches onto vertical surfaces.
- 9. Seal membrane around roof penetrations.

D. Flashings and Accessories:

- 1. Apply flexible flashings to seal membrane to vertical elements.
- 2. Secure to nailing strips at 4 inches o.c. and reglets.
- 3. Fabricate roofing control joints to isolate roof into areas as indicated on Drawings, and make joints watertight.
- 4. Coordinate installation of roof drains and related flashings.
- 5. Seal flashings and flanges of items penetrating membrane.

### 3.4 FIELD QUALITY CONTROL

- A. Section 017000 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Require daily Site attendance of roofing and insulation material manufacturers during installation of Work of this Section.

### 3.5 CLEANING

- A. Section 017000 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Where finished surfaces are soiled by Work of this Section, consult surfaces manufacturer for cleaning advice and conform to manufacturer's instructions.
- C. Repair or replace defaced or disfigured finishes caused by Work of this Section.

### 3.6 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect building surfaces against damage from roofing Work.
- C. Do not permit traffic over unprotected floor surfaces.

END OF SECTION



## SECTION 07 62 00

### SHEET METAL FLASHING AND TRIM

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Flashings and counterflashings.
  - 2. Accessories.
  - 3. Other fabricated sheet metal items required to keep building weathertight and not specified elsewhere.
- B. Related Requirements:
  - 1. Section 06 10 53 - Miscellaneous Rough Carpentry: Wood blocking for metal roofing substrate profiles.
  - 2. Section 07 71 23 - Manufactured Gutters and Downspouts: Shop- or Site-fabricated metal or plastic rainwater gutters and downspouts.
  - 3. Section 07 90 00 - Joint Protection: Sealants and sealers.
  - 4. Section 09 90 00 - Painting and Coating: Field painting.

##### 1.2 REFERENCE STANDARDS

- A. Aluminum Association:
  - 1. AA - Designation System for Aluminum Finishes.
- B. American Architectural Manufacturers Association:
  - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
  - 2. AAMA 612 - Voluntary Specification, Performance Requirements, and Test Procedures for Combined Coatings of Anodic Oxide and Transparent Organic Coatings on Architectural Aluminum.
  - 3. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - 4. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.
  - 5. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
- C. ASTM International:
  - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
  - 2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
  - 3. ASTM D4397 - Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.



4. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free.

D. Federal Specification Unit:

1. FS TT-C-494 - Coating Compound, Bituminous, Solvent Type, Acid Resistant.

E. National Roofing Contractors Association:

1. NRCA - Construction Details Manual.

F. Sheet Metal and Air Conditioning Contractors' National Association:

1. SMACNA - Architectural Sheet Metal Manual.

G. Specialty Steel Industry of North America:

1. SSINA - Standard Practices for Stainless Steel Roofing, Flashing, Copings.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.

- B. Convene minimum one week prior to commencing Work of this Section.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.

- B. Product Data: Submit manufacturer information regarding components metal types, finishes, and characteristics.

- C. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

D. Samples:

1. Submit two samples, 6 by 6 inches in size, illustrating metal finish color.

- E. Fabricator's Certificate: Certify that products meet or exceed specified requirements.

F. Qualifications Statements:

1. Submit qualifications for fabricator and installer.

### 1.6 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum five years' experience.



- B. Installer: Company specializing in performing Work of this Section with minimum five years' experience.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Storage:
  - 1. Store materials according to manufacturer instructions.
  - 2. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation.
  - 3. Slope metal sheets to ensure drainage.
- D. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Prevent contact with materials that may cause discoloration or staining.
  - 3. Provide additional protection according to manufacturer instructions.

## PART 2 - PRODUCTS

### 2.1 SHEET METAL FLASHING AND TRIM

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Cheney Flashing Company.
  - 2. Keystone Flashing Company.
  - 3. Hohmann & Barnard, Inc.
- B. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- C. Performance and Design Criteria:
  - 1. Sheet Metal Flashings: Comply with applicable criteria of SMACNA Manual:
- D. Prefinished Aluminum Sheet:
  - 1. Description: Alloy and temper as required for application and finish.
  - 2. Comply with ASTM B209.
  - 3. Thickness: 0.032 inch.
  - 4. Finish: Plain.
  - 5. Coating:
    - a. Shop precoated with three-coat fluoropolymer.
    - b. Color: As selected from manufacturer's standard.



## 2.2 FABRICATION

- A. Form section shapes as indicated on Drawings, accurate in size, square, and free from distortion or defects.
- B. Fabricate cleats of same material as sheet metal, interlocking with sheet.
- C. Form pieces in longest possible lengths.
- D. Hem exposed edges on underside 1/2 inch.
- E. Miter and seam corners.
- F. Forming:
  - 1. Form material with flat lock seams, except where otherwise indicated.
  - 2. At moving joints, use sealed, lapped, bayonet-type, or interlocking hooked seams.
- G. Corners:
  - 1. Fabricate corners from one piece with minimum 18-inch long legs.
  - 2. Seam for rigidity and seal with sealant.
- H. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- I. Flashings:
  - 1. Fabricate flashings to allow toe to extend 2 inches over roofing.
  - 2. Return and brake edges.

## 2.3 FINISHES

- A. Fluoropolymer Coating:
  - 1. Description: Multiple coats as specified for sheet metal system and thermally cured.
  - 2. Comply with AAMA 2604 or 2605.
- B. Washcoat: Finish concealed side of metal sheets with washcoat compatible with finish system, as recommended by finish system manufacturer.

## 2.4 ACCESSORIES

- A. Fasteners: Aluminum.
- B. Underlayment:
  - 1. Material: Polyethylene.
  - 2. Comply with ASTM D4397.
  - 3. Thickness: 10 mils.
- C. Slip Sheet: Rosin-sized building paper.
- D. Primer: Zinc molybdate.



- E. Protective Backing Paint: Zinc-molybdate alkyd.
- F. Sealant:
  - 1. Type: Silicone.
- G. Plastic Cement: Comply with ASTM D4586/D4586M, Type I.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets are in place, and nailing strips have been located.
- C. Verify that roofing termination and base flashings are in place, sealed, and secure.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation preparation.
- B. Install starter strips, edge strips, and cleats before starting installation of sheet metal flashing and trim.
- C. Paint concealed metal surfaces with protective backing paint to minimum dry film thickness of 15 mils.

END OF SECTION



## SECTION 07 84 00

### FIRESTOPPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.
  - 2. Penetrations in horizontal assemblies.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Schedule: For each penetration firestopping system. Include location and design designation of qualified testing and inspecting agency.
  - 1. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Installer Certificates: From Installer indicating penetration firestopping has been installed in compliance with requirements and manufacturer's written recommendations.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for penetration firestopping.

##### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A firm experienced in installing penetration firestopping similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.
- B. Fire-Test-Response Characteristics: Penetration firestopping shall comply with the following requirements:
  - 1. Penetration firestopping tests are performed by a qualified testing agency acceptable to authorities having jurisdiction.



2. Penetration firestopping is identical to those tested per testing standard referenced in "Penetration Firestopping" Article. Provide rated systems complying with the following requirements:
  - a. Penetration firestopping products bear classification marking of qualified testing and inspecting agency.
  - b. Classification markings on penetration firestopping correspond to designations listed by the following:
    - 1) UL in its "Fire Resistance Directory."

## 1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install penetration firestopping when ambient or substrate temperatures are outside limits permitted by penetration firestopping manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.
- B. Install and cure penetration firestopping per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

## 1.6 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping is installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping.
- C. Notify Owner's testing agency at least seven days in advance of penetration firestopping installations; confirm dates and times on day preceding each series of installations.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Grace Construction Products.
  2. Hilti, Inc.
  3. Johns Manville.

### 2.2 PENETRATION FIRESTOPPING

- A. Provide penetration firestopping that is produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.





- B. Penetrations in Fire-Resistance-Rated Walls: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. Fire-resistance-rated walls include fire-barrier walls and fire partitions.
  - 2. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
- C. Penetrations in Horizontal Assemblies: Provide penetration firestopping with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. Horizontal assemblies include ceiling membranes of roof/ceiling assemblies.
  - 2. F-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated.
  - 3. T-Rating: At least 1 hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
- D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping manufacturer and approved by qualified testing and inspecting agency for firestopping indicated.
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-wool-fiber or rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.
    - c. Fire-rated form board.
    - d. Fillers for sealants.
  - 2. Temporary forming materials.
  - 3. Substrate primers.
  - 4. Collars.
  - 5. Steel sleeves.

## 2.3 FILL MATERIALS

- A. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- B. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- C. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing penetration firestopping to comply with manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

### 3.3 INSTALLATION

- A. General: Install penetration firestopping to comply with manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestopping.
- C. Install fill materials for firestopping by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.

### 3.4 IDENTIFICATION

- A. Identify penetration firestopping with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of firestopping edge so labels will be visible to anyone seeking to remove penetrating items or firestopping. Use



mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

### 3.5 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Where deficiencies are found or penetration firestopping is damaged or removed because of testing, repair or replace penetration firestopping to comply with requirements.
- C. Proceed with enclosing penetration firestopping with other construction only after inspection reports are issued and installations comply with requirements.

### 3.6 CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping is without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping and install new materials to produce systems complying with specified requirements.

### 3.7 PENETRATION FIRESTOPPING SCHEDULE

- A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestopping with No Penetrating Items:
  1. UL-Classified Systems: W-L- 0001-0999.
- C. Firestopping for Metallic Pipes, Conduit, or Tubing:
  1. UL-Classified Systems: W-L- 1001-1999.
- D. Firestopping for Nonmetallic Pipe, Conduit, or Tubing:
  1. UL-Classified Systems: W-L- 2001-2999.
- E. Firestopping for Electrical Cables:
  1. UL-Classified Systems: W-K- 3001-3999.



- F. Firestopping for Insulated Pipes:
  - 1. UL-Classified Systems: W-L- 5001-5999.
- G. Firestopping for Miscellaneous Electrical Penetrants:
  - 1. UL-Classified Systems: W-L- 6001-6999.
- H. Firestopping for Miscellaneous Mechanical Penetrants:
  - 1. UL-Classified Systems: W-L- 7001-7999

END OF SECTION



## SECTION 07 90 00

### JOINT PROTECTION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Latex joint sealants.
- B. Related Sections:
  - 1. Section 08 80 00 "Glazing" for glazing sealants.
  - 2. Section 09 29 00 "Gypsum Board" for sealing perimeter joints.
  - 3. Section 09 30 00 "Tiling" for sealing tile joints.
  - 4. Section 09 51 13 "Acoustical Panel Ceilings" for sealing edge moldings at perimeters with acoustical sealant.

##### 1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
  - 1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  - 2. Conduct field tests for each application indicated below:
    - a. Each kind of sealant and joint substrate indicated.
  - 3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  - 4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  - 5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  - 6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.



- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
  - 1. Joint-sealant application, joint location, and designation.
  - 2. Joint-sealant manufacturer and product name.
  - 3. Joint-sealant formulation.
  - 4. Joint-sealant color.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and testing agency.
- B. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- D. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- E. Field-Adhesion Test Reports: For each sealant application tested.
- F. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

#### 1.6 PROJECT CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:



1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

## 1.7 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
  1. Warranty Period: Two years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from natural causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.



- D. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 100/50, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Dow Corning Corporation; 790.
    - b. Pecora Corporation; 301 NS.
    - c. Sika Corporation, Construction Products Division; SikaSil-C990.
- B. Mildew-Resistant, Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Pecora Corporation; 898.

## 2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Bostik, Inc.; Chem-Calk 600.
    - b. Pecora Corporation; AC-20+.
    - c. Tremco Incorporated; Tremflex 834.

## 2.4 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.5 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.





- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.
    - b. Unglazed surfaces of ceramic tile.
  - 3. Remove laitance and form-release agents from concrete.
  - 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    - a. Metal.
    - b. Glass.
    - c. Porcelain enamel.
    - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.



- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  - 1. Remove excess sealant from surfaces adjacent to joints.
  - 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  - 3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
  - 1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.



2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
  - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
3. Inspect tested joints and report on the following:
  - a. Whether sealants filled joint cavities and are free of voids.
  - b. Whether sealant dimensions and configurations comply with specified requirements.
  - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:



- a. Construction joints in cast-in-place concrete.
    - b. Joints between different materials listed above.
    - c. Perimeter joints between materials listed above and frames of doors and windows.
    - d. Control and expansion joints in ceilings and other overhead surfaces.
  2. Silicone Joint Sealant: Single component, nonsag, neutral curing, Class 100/50.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:
    - a. Isolation joints in cast-in-place concrete slabs.
    - b. Control and expansion joints in tile flooring.
  2. Silicone Joint Sealant: Single component, nonsag, traffic grade, neutral curing.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Perimeter joints of exterior openings where indicated.
    - c. Tile control and expansion joints.
    - d. Vertical joints on exposed surfaces of walls and partitions.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
  2. Joint Sealant: Latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Sealant Location:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
  2. Joint Sealant: Mildew resistant, single component, nonsag, neutral curing, Silicone.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
1. Joint Location:
    - a. Acoustical joints where indicated.
    - b. Other joints as indicated.
  2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION



## SECTION 08 12 13.13

### STANDARD HOLLOW METAL FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes non-rated steel frames.
- B. Related Sections:
  - 1. Section 08 71 00 - Door Hardware: Hardware for door hardware for wood doors.

##### 1.2 REFERENCES

- A. American National Standards Institute:
  - 1. ANSI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
- B. ASTM International:
  - 1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. Underwriters Laboratories Inc.:
  - 1. UL 10B - Fire Tests of Door Assemblies.
  - 2. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
  - 3. UL 1784 - Air Leakage Tests of Door Assemblies.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate frame elevations, reinforcement, anchor types and spacing, location of cut-outs for hardware and finish.
- C. Product Data: Submit frame configuration and finishes.
- D. Manufacturer's Installation Instructions: Submit special installation instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

##### 1.4 QUALITY ASSURANCE

- A. Conform to requirements of ANSI A250.8.
- B. Perform Work in accordance with State of Maine Educational standards.



## 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of three years' experience.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept frames on site in manufacturer's packaging. Inspect for damage.
- C. Break seal on-site to permit ventilation.

## 1.7 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with frame opening construction, door, and hardware installation.
- C. Sequence installation to accommodate required door hardware electric wire connections.

# PART 2 - PRODUCTS

## 2.1 STANDARD STEEL FRAMES

- A. Manufacturers:
  - 1. Ceco Door Products; as Assa Abloy Group company.
  - 2. Curries Company.
  - 3. De La Fontaine, Industries.
  - 4. J/R Metal Frames Manufacturing, Inc.
  - 5. Steelcraft; a division of Ingersoll-Rand.
  - 6. Substitutions: Section 01 60 00 - Product Requirements.
- B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.
  - 1. Frames: To suit ANSI A250.8 Grade and Model of door specified in Section 08 13 14.

## 2.2 ACCESSORIES

- A. Primer: ANSI A250.10 rust inhibitive type.
- B. Silencers: Resilient rubber fitted into drilled hole.

## 2.3 FABRICATION

- A. Fabricate frames for gypsum board slip on type.
- B. Mullions for Double Doors: Removable type, of same profiles as jambs.



- C. Transom Bars for Glazed Lights: Fixed type, of same profiles as jamb and head.
- D. Fabricate frames with hardware reinforcement plates welded in place.
- E. Reinforce frames wider than 48 inches with roll formed steel channels fitted tightly into frame head, flush with top.
- F. Prepare frames for silencers. Provide three single silencers for single doors on strike side. Provide two single silencers on frame head at double doors without mullions.
- G. Attach fire rated label to each fire rated frame.
- H. Fabricate frames to suit masonry wall coursing with 4-inch head member.

## 2.4 SHOP FINISHING

- A. Steel Sheet: Galvanized to ASTM A653/A653M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify opening sizes and tolerances are acceptable.

### 3.2 INSTALLATION

- A. Install frames in accordance with ANSI A250.8.
- B. Coordinate with gypsum board wall construction for anchor placement.
- C. Coordinate installation of glass and glazing specified in Section 08 80 00.
- D. Coordinate installation of frames with installation of hardware specified in Section 087100 and doors in Section 08 14 16.
- E. Install roll formed steel reinforcement channels between two abutting frames. Anchor to structure and floor.

### 3.3 ERECTION TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Diagonal Distortion: 1/16 -inch measured with straight edges, crossed corner to corner.

END OF SECTION



SECTION 08 14 16  
FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Flush wood doors.
  - 2. Door glazing.
- B. Related Requirements:
  - 1. Section 08 12 14 - Standard Steel Frames.
  - 2. Section 08 71 00 - Door Hardware.

1.2 REFERENCE STANDARDS

- A. American National Standards Institute:
  - 1. ANSI A135.4 - Basic Hardboard.
- B. ASTM International:
  - 1. ASTM C1048 - Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.
  - 2. ASTM E413 - Classification for Rating Sound Insulation.
- C. Architectural Woodwork Institute:
  - 1. AWI AWS - Architectural Woodwork Standards.
- D. Consumer Products Safety Commission:
  - 1. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing.
- E. Forest Stewardship Council:
  - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- F. Hardwood Plywood and Veneer Association:
  - 1. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood.
- G. National Electrical Manufacturers Association:
  - 1. NEMA LD 3 - High Pressure Decorative Laminates.
- H. National Fire Protection Association:
  - 1. NFPA 80 - Standard for Fire Doors, Fire Windows.
  - 2. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and other Opening Protectives.
  - 3. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.





- I. National Institute of Justice
  - 1. NIH 0108.1 - Ballistic Resistant Protective Materials.
- J. Underwriters Laboratories Inc.:
  - 1. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
  - 2. UL 1784 - Air Leakage Tests of Door Assemblies.
- K. Wood Window and Door Manufacturers Association:
  - 1. WDMA I.S 1A - Architectural Wood Flush Doors.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work with door opening construction, door frame and door hardware installation.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
  - 1. Submit data for door core materials and construction.
  - 2. Submit data for veneer species, type and characteristics.
  - 3. Submit data for factory finishes.
- C. Shop Drawings:
  - 1. Indicate door opening criteria, elevations, sizes, types, swings, and factory machining criteria.
  - 2. Indicate cutouts for glazing.
- D. Manufacturers' Instructions: Submit special installation instructions.
- E. Qualification Statements:
  - 1. Submit manufacturer experience qualifications.

### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with AWI AWS Section 9, Premium Grade.
- B. Perform Work in accordance with Maine Educational standards.

### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.



## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect doors with resilient packaging. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer when stored more than one week.
- B. Accept doors on site in manufacturer's packaging. Inspect for damage.
  - 1. Break seal on site to permit ventilation.

## 1.8 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.
- C. Interior Doors:
  - 1. Factory Finished Doors: Furnish manufacturer's life of installation warranty.
  - 2. Field Finished Doors: Furnish manufacturer's two-year warranty.

## PART 2 - PRODUCTS

### 2.1 FLUSH WOOD DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Eggers Industries.
  - 2. Graham Wood Doors; an Assa Abloy Group company.
  - 3. Marshfield – Algoma.
  - 4. VT Industries Inc.
  - 5. Substitutions: Section 01 60 00 - Product Requirements.
- B. Flush Interior Doors: Solid core.
  - 1. Thickness: 1-3/4 inches.
  - 2. Core: for Non-Fire Rated Doors.
  - 3. Face Construction: Five ply.
  - 4. Performance Duty Level: Heavy duty.
  - 5. Quality Grade: Premium.
- C. Performance / Design Criteria:
  - 1. Performance Duty Level: WDMA I.S. 1A.
  - 2. Sound Transmission Resistance: ASTM E413; minimum STC 35 for door and frame assemblies indicated as acoustically rated.
  - 3. Bullet Resistant: NIH 0108.1; minimum Level 2 for doors indicated as bullet resistant rated.
  - 4. Electrostatic Shielded: for doors indicated as electrostatically shielded.



## 2.2 FABRICATION

- A. Fabricate doors in accordance with AWI AWS Section 9 requirements.
- B. Furnish lock blocks at lock edge and top of door for closer for hardware reinforcement.
- C. Fit door edge trim to edge of stiles after applying veneer facing.
- D. Bond edge banding to cores.
- E. Factory machine doors for finish hardware in accordance with hardware requirements and dimensions. Do not machine for surface hardware.

## 2.3 FINISHES

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on bottom edges, edges of cutouts and mortises.
- B. Factory finish doors.
- C. Transparent Finish System:
  - 1. Grade: Premium.
  - 2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
  - 3. Staining: None required.
  - 4. Effect: Open grain finish.
  - 5. Sheen: Satin.

## 2.4 ACCESSORIES

- A. Door Glazing:
  - 1. Glass: ASTM C1048, Type 1 transparent flat, Quality Q3, Kind FT fully tempered, Condition A uncoated, float glass with horizontal tempering; conforming to CPSC 16 CFR 1201 Category II.
  - 2. Glazing Stops: Wood with metal clips for rated doors.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.



### 3.2 INSTALLATION

- A. Install doors in accordance with AWI AWS Section 9 and manufacturer's instructions.
- B. Coordinate installation of doors with installation of frames specified in Section 08 12 13.13 and hardware specified in Section 087100.
- C. Coordinate installation of glass and glazing specified in Section 088000.

### 3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Conform to AWI AWS Section 9 requirements for the following:
  - 1. Fit and clearance tolerances.
  - 2. Gaps.
  - 3. Flushness.
  - 4. Flatness.
  - 5. Squareness.

### 3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust door for smooth and balanced door movement.
- C. Adjust door closer for full closure.

END OF SECTION



## SECTION 08 41 13

### ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Aluminum-framed storefronts.
  - 2. Aluminum and glass doors and frames.
- B. Related Requirements:
  - 1. Section 05 50 00 - Metal Fabrications: Steel-fabricated attachment devices for framed openings.
  - 2. Section 07 26 00 - Vapor Retarders: Perimeter vapor seal between glazing system and adjacent construction.
  - 3. Section 07 27 00 - Air Barriers: Perimeter air seal between glazing system and adjacent construction.
  - 4. Section 07 90 00 - Joint Protection: System perimeter sealant and backup materials.
  - 5. Section 08 44 13 - Glazed Aluminum Curtain Walls: Tubular aluminum exterior curtain wall systems.
  - 6. Section 08 71 00 - Door Hardware: Mortised hardware reinforcement requirements affecting framing members, and hardware items other than specified in this Section.
  - 7. Section 08 80 00 - Glazing: Exterior and interior glazing materials and methods.

##### 1.2 REFERENCE STANDARDS

- A. American Architectural Manufacturers Association/Window & Door Manufacturers Association:
  - 1. AAMA/WDMA 101/I.S.2 - North American Fenestration Standard/Specification for windows, doors, and skylights.
  - 2. AAMA 502 - Voluntary Specification for Field Testing of Newly Installed Fenestration Products.
  - 3. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems.
  - 4. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum.
  - 5. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
  - 6. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels.
  - 7. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels.



8. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels.
9. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site.
10. AAMA MCWM-1 - Metal Curtain Wall Manual.
11. AAMA SFM-1 - Aluminum Storefront and Entrance Manual.

B. American Society of Civil Engineers:

1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.

C. ASTM International:

1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
4. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
5. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
6. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference.
7. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Difference.
8. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference.
9. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.

D. International Energy Conservation Code:

1. IECC Climate Zone Map.

E. SSPC: The Society for Protective Coatings:

1. SSPC Paint 20 - Zinc-Rich Coating (Type I - Inorganic and Type II - Organic).
2. SSPC Paint 25 - Zinc Oxide, Alkyd, Linseed Oil Primer for Use Over Hand Cleaned Steel (Type I and Type II).

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.



#### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.

#### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit component dimensions, description of components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, and expansion and contraction joint location and details.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
  - 1. Submit qualifications for manufacturer, installer, and licensed professional.
  - 2. Submit manufacturer's approval of installer.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this Section with minimum three years' experience and approved by manufacturer.
- C. Licensed Professional: Professional engineer experienced in design of specified Work and licensed in State of Maine.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling: Comply with AAMA CW-10.
- D. Store products according to manufacturer instructions.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Protect finished aluminum surfaces with wrapping.



3. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.
4. Provide additional protection according to manufacturer instructions.

#### 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Do not install sealants or glazing materials if ambient temperature is less than 40 deg. F during and 48 hours after installation.

#### 1.9 EXISTING CONDITIONS

- A. Field Measurements:
  1. Verify field measurements prior to fabrication.
  2. Indicate field measurements on Shop Drawings.

#### 1.10 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish two-year manufacturer's warranty for aluminum framing components and assemblies.
- C. Furnish 10-year manufacturer's warranty for aluminum finishes.

### PART 2 - PRODUCTS

#### 2.1 SYSTEM DESCRIPTION

- A. Aluminum-framed, shop-fabricated, and factory-finished storefront system with tubular aluminum sections and aluminum and glass entrances.
- B. Furnish systems with glass and glazing, related flashings, anchorages, and attachment devices.
- C. System Assembly: On Site.

#### 2.2 PERFORMANCE AND DESIGN CRITERIA

- A. System Design:
  1. Design and size components to withstand dead and live loads caused by positive and negative wind pressure acting normal to plane of wall, including building corners.
  2. Testing: Comply with ASTM E330/E330M.
  3. Calculation:
    - a. Comply with applicable code.





- B. Windborne Debris Loads:
  - 1. Design and size glass located less than 60 feet above grade to withstand following loads:
    - a. Glass within 30 Feet of Grade: Comply with ASTM E1886 and ASTM E1996; large-missile impact test.
    - b. Glass Greater Than 30 Feet above Grade: Comply with ASTM E1886 and ASTM E1996; small-missile impact test.
- C. Deflection:
  - 1. Framing Deflection Limit:  $1/175$  for spans under 13-1/2 feet and  $1/240$  plus 1/4 inch for spans over 13-1/2 feet Flexure limit of glass 3/4 inch.
  - 2. Ensure full recovery of glazing materials.
- D. System Assembly: Without damage to components or deterioration of seals, accommodate movement within system, movement between system and peripheral construction, dynamic loading and release of loads, and deflection of structural support framing.
- E. Air Infiltration:
  - 1. Maximum through Assembly: 0.06 cfm /sq. ft. of wall area.
  - 2. Reference Differential Pressure across Assembly:
    - a. 1.57 psf.
    - b. Measurement: Comply with AAMA/WDMA 101/I.S.2, ASTM E283.
- F. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily inline with inside pane of glass, inner sheet of infill panel, and heel bead of glazing compound.
- G. Condensation-Resistance Factor: Not less than 45 when measured according to AAMA 1503.
- H. Water Leakage:
  - 1. None.
  - 2. Measurement:
    - a. Comply with AAMA/WDMA 101/I.S.2.
    - b. Test Pressure Difference: 10 psf.
- I. Thermal and Solar Heat Transmittance of Assembly (U-Value and Solar Heat Gain Coefficient): Comply with IECC for climate zone in which Project is located.
- J. Expansion/Contraction: Ensure that system components can withstand expansion and contraction caused by minimum cycling temperature range of 170 deg. F over a 12-hour period, without causing detrimental effect to system components or anchorage.
- K. System Internal Drainage: Furnish weep drainage network to drain water to exterior, including water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system.



## 2.3 ALUMINUM-FRAMED STOREFRONTS

- A. Manufacturers:
  - 1. EFCO.
  - 2. Kawneer.
  - 3. Tubelite.
  - 4. Oldcastle.
  - 5. YKK AP.
  - 6. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- B. Description:
  - 1. Aluminum Frame:
    - a. Frames for Exterior: Thermally broken.
    - b. Frames for Interior: Nonthermally broken.
    - c. Glazing Stops: Flush.
    - d. Furnish drainage holes and internal weep drainage system.
  - 2. Mullions:
    - a. Profile: Match frame.
  - 3. Aluminum-Framed Glass Doors:
    - a. Thickness: 2 inches
    - b. Top Rail and Stile Width: 5 inches
    - c. Bottom Rail Width: 10 inches
    - d. Glazing Stops: Square.

## 2.4 MATERIALS

- A. Extruded Aluminum:
  - 1. Comply with ASTM B221 (B221M).
  - 2. Alloy:
    - a. 6063.
    - b. Extruded Structural Members: 6061.
  - 3. Temper:
    - a. T5.
    - b. Extruded Structural Members: T6.
- B. Glass: As specified in Section 08 80 00 - Glazing.
- C. Glazing Materials: As specified in Section 08 80 00 - Glazing
- D. Sealant and Backing Materials:
  - 1. Sealant Used within System and Not Used for Glazing: Manufacturer's standard materials to achieve weather, moisture, and air infiltration requirements.
  - 2. Perimeter Sealant: As specified in Section 07 90 00 - Joint Protection.
- E. Fasteners: Stainless steel.



## 2.5 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Joints and Corners:
  - 1. Accurately fit and secure joints and corners.
  - 2. Make joints flush weatherproof and hairline.
- C. Provide for interior replacement of glazing.
- D. Provide means to drain water passing joints, condensation within framing members, and moisture migrating within system to exterior.
- E. Provide physical and thermal isolation of glazing from framing members.
- F. Arrange fasteners and attachments to conceal from view.
- G. Prepare components with internal reinforcement for door hardware.
- H. Reinforce framing members for imposed loads.

## 2.6 FINISHES

- A. Clear Anodized Aluminum Surfaces:
  - 1. AAMA 611, AA-M12C22A41, AA-M12C22A31.
  - 2. Coating: Architectural Class I, 0.7 mils.
- B. Application:
  - 1. Apply factory coating to surfaces exposed at completed assemblies.
  - 2. Apply finish to surfaces cut during fabrication such that no natural aluminum is visible in completed assemblies, including joint edges.
  - 3. Apply touchup materials recommended by coating manufacturer for field application to cut ends and minor damage to factory-applied finish.

## 2.7 ACCESSORIES

- A. Hardware:
  - 1. Furnish manufacturer's standard door hardware for types of doors and for indicated applications.
  - 2. Weather Stripping, Sill Sweep Strips, Thresholds, Hinges, Push-Pull Handles, Panic Devices, and Closers: Manufacturer's standard type to suit application.
  - 3. Sill Sweep Strips:
    - a. Material: Neoprene compound.
    - b. Seal Type: Resilient and retracting.
  - 4. Threshold:
    - a. Description: One piece for each door opening; accessible type.
    - b. Material: Extruded aluminum.
    - c. Surface: Ribbed, nonslip.



5. Hinges:
  - a. Number: Three per leaf.
  - b. Butt Type: Center.
6. Panic Device:
  - a. Description: concealed vertical rod device.
  - b. Type: Push pad.
7. Closers:
  - a. Type: Fully adjustable, accessible.
  - b. Mounting: Overhead exposed, inside mounted.
8. Exposed Hardware Finishes: Match door finish.
9. Lock Cylinders: As specified in Section 08 71 00 - Door Hardware.

B. Flashings: Minimum 0.025-inch thick stainless steel.

C. Air Barriers: As specified in Section 07 27 00 - Air Barriers.

## 2.8 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for testing, inspection, and analysis.
- B. Provide shop inspection and testing of completed assembly.
- C. Owner Inspection:
  1. Make completed entrances available for inspection at manufacturer's factory prior to packaging for shipment.
  2. Notify Owner at least seven days before inspection is allowed.
- D. Owner Witnessing:
  1. Allow witnessing of factory inspections and tests at manufacturer's test facility.
  2. Notify Owner at least seven days before inspections and tests are scheduled.
- E. Certificate of Compliance:
  1. If manufacturer is approved by authorities having jurisdiction, submit certificate of compliance indicating Work performed at manufacturer's facility conforms to Contract Documents.
  2. Specified shop tests are not required for Work performed by approved manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify dimensions, tolerances, and method of attachment with other Work.



- C. Verify that wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

### 3.2 INSTALLATION

- A. Comply with AAMA MCWM-1.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist.
- E. Maintain assembly dimensional tolerances aligning with adjacent Work.
- F. Provide thermal isolation where components penetrate or disrupt building insulation.
- G. Sill Flashings:
  - 1. Turn up ends and edges.
  - 2. Seal to adjacent Work to form watertight dam.
- H. Coordinate attachment and seal of perimeter air and vapor retarder materials.
- I. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Install integral flashings and integral joint sealers.
- K. Set sills and thresholds in bed of mastic and secure.
- L. Hardware:
  - 1. As specified in Section 08 71 00 - Door Hardware.
- M. Infill Panels: Use method as required to achieve performance criteria.
- N. Glass:
  - 1. As specified in Section 08 80 00 - Glazing.
  - 2. Separate glass from metal surfaces.
- O. Perimeter Sealants: As specified in Section 07 90 00 - Joint Protection.

### 3.3 TOLERANCES

- A. Section 014000 - Quality Requirements: Requirements for tolerances.
- B. Maximum Variation from Plumb: 0.06 in./3 ft. noncumulative, or 1/16 in./10 ft whichever is less.



- C. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.
- B. Field Testing: Comply with AAMA Standards.
- C. Equipment Acceptance:
  - 1. Adjust, repair, modify, or replace components failing to perform as specified and rerun tests.

### 3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust operating hardware for smooth operation.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove protective material from prefinished aluminum surfaces.
- C. Surfaces:
  - 1. Wash down with solution of mild detergent in warm water.
  - 2. Apply with soft, clean wiping cloths.
  - 3. Wipe surfaces clean.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

### 3.7 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect finished Work from damage.

END OF SECTION



## SECTION 08 53 00

### PLASTIC WINDOWS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Factory fabricated tubular extruded plastic windows.
  - 2. Factory glazing.
  - 3. Operating hardware.
  - 4. Insect screens.
- B. Related Requirements:
  - 1. Section 06 10 00 - Rough Carpentry: Wood framed openings.
  - 2. Section 07 26 00 - Vapor Retarders: Perimeter vapor seal between window frame and adjacent construction.
  - 3. Section 07 27 00 - Air Barriers: Perimeter air seal between window frame and adjacent construction.
  - 4. Section 07 90 00 - Joint Protection: Perimeter sealant and back-up materials.

##### 1.2 REFERENCE STANDARDS

- A. American Architectural Manufacturers Association:
  - 1. AAMA 101 - Voluntary Performance Specification for Windows, Skylights and Glass Doors.
  - 2. AAMA 303 - Voluntary Specification for Poly (Vinyl Chloride) (PVC) Exterior Profile Extrusions.
  - 3. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- B. American Society of Civil Engineers:
  - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.
- C. ASTM International:
  - 1. ASTM D3656 - Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns.
  - 2. ASTM D4726 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Exterior-Profile Extrusions Used for Assembled Windows and Doors.
  - 3. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
  - 4. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.
  - 5. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors By Uniform Static Air Pressure Difference.



6. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential.
7. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Curtain Walls, and Doors by Uniform or Cyclic Static Air Pressure Difference.
8. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact.
9. ASTM E1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
10. ASTM E1996 - Standard Specification for Performance of Exterior Windows, Curtain Walls, Doors and Impact Protective Systems Impacted by Windborne Debris in Hurricanes.

D. Glass Association of North America:

1. GANA - Glazing Manual.

E. National Fenestration Rating Council Incorporated:

1. NFRC 100 - Procedures for Determining Fenestration Product U-Factors.

### 1.3 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit component dimensions, anchorage and fasteners, glass, internal drainage, and typical details.
- C. Shop Drawings: Indicate opening dimensions, framed opening tolerances, affected related Work; and installation requirements.
- D. Manufacturer's Certificates: Certify Product performance ratings by independent third party such as AAMA, CAWM, or NFRC as meeting or exceeding specified requirements.

### 1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with the following:
  1. PVC Windows: Fabricate and label window assemblies in accordance with AAMA 101 for types of windows required.
  2. Maintain one copy of each document on site.
  3. Insulated Glass: Fabricate insulated glass units in accordance with GANA (formerly FGMA) Glazing Manual.





- B. Perform Work in accordance with State standard.
- C. Perform Work in accordance with Maine Educational standards.
- D. Maintain one copy copies of each document on Site.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing commercial PVC windows with minimum three years documented experience.
- B. Installer: Company specializing in installation of commercial PVC windows with minimum three years documented experience.

## 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Protect finished surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond when exposed to sunlight or weather.
- C. Jig, brace, and box window frame assemblies for transport to minimize flexing of members and to minimize flexing of joints.

## 1.8 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Section 01 60 00 - Product Requirements.
- C. Do not install glazing materials when ambient temperature is less than 40 degrees F.
- D. Maintain this minimum temperature during and after installation of sealants.

## 1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish 20 year manufacturer's warranty for insulated glass units from seal failure, interpane dusting or misting, and replacement of same.
- C. Furnish 10 year manufacturer's warranty for degradation of plastic color finish.

# PART 2 - PRODUCTS

## 2.1 TUBULAR PLASTIC WINDOWS

- A. Manufacturers:



1. Paradigm Premium Fixed Window with 5" Brick Mold.
2. Substitutions: Section 01 60 00 - Product Requirements.

B. Furnish materials in accordance with State standards.

## 2.2 COMPONENTS

- A. Extruded PVC: AAMA 303 hollow, multi-chambered sections of extruded polyvinyl chloride (PVC), with integral ultra-violet degradation resistance.
- B. Insulating Glass: Sealed double pane units conforming with requirements in Section 08 80 00.
1. Outer Pane: Low E float glass.
  2. Inner Pane: Clear float glass.
  3. Pane Thickness: Minimum 1/8 inch thick.
  4. Minimum Total Unit Thickness: 3/4 inch.
  5. Glazing Materials: Manufacturer's standard conforming with requirements specified in Section 08 80 00.
- C. Infill Panel: Internally reinforced, glazing edge sealed permitting internal air movement to glazing space, outside air barrier line:
1. Panel Sheet: Minimum 1/4 inch thick aluminum.
- D. Sills: Tubular plastic; sloped for positive wash; fit under sash to 1/2 inch beyond wall face; one-piece full width of opening.

## 2.3 FABRICATION

- A. Fabricate framing, mullions and sash members with fusion welded corners and joints, in rigid jig. Supplement frame sections with internal reinforcement where required for structural rigidity.
- B. Form sills in one piece. Slope sills for wash.
- C. Form snap-in glass stops, closure molds, weather stops, and flashings of extruded PVC for tight fit into window frame section.
- D. Form weather stop flange to perimeter of unit.

Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

Arrange fasteners to be concealed from view. Permit internal drainage weep holes and channels to migrate moisture to exterior.

- E. Furnish internal drainage of glazing spaces to exterior through weep holes.

Factory glaze window units. Furnish glass and infill panels in accordance with Section 08 80 00, to exterior wet/dry method of glazing.



## 2.4 FINISHES

- A. Exterior Surfaces: Manufacturer's Anthracite Grey.
- B. Interior Surfaces: Manufacturer's standard white.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify wall openings and adjoining air and vapor seal materials are ready to receive Work of this Section.

### 3.2 INSTALLATION

- A. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- B. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent Work.
- C. Install sill.
- D. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- E. Coordinate attachment and seal of perimeter air and vapor retarder materials.

### 3.3 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting, testing.
- B. Inspection will monitor quality of installation and glazing.

### 3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.



- B. Adjust hardware for smooth operation and secure weathertight closure.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove protective material from pre-finished surfaces.
- C. Wash surfaces by method recommended and acceptable to sealant and window manufacturer; rinse and wipe surfaces clean.
- D. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION



## SECTION 08 56 53

### SECURITY WINDOWS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Fixed, transaction security windows.
- B. Related Sections:
  - 1. Division 09 Section "Interior Painting" for field painting interior security windows.

##### 1.3 PERFORMANCE REQUIREMENTS

- A. Ballistics-Resistance Performance: Provide units identical to those tested for compliance with requirements indicated, and as follows:
  - 1. Listed and labeled as bullet resisting according to UL 752.

##### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.
- B. Shop Drawings: For security windows. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
  - 2. Location of weep holes.
  - 3. Glazing details.
  - 4. Details of deal tray, transaction counter and speaking aperture.
- C. Samples for Initial Selection: For frame members with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
  - 1. Framing: 12-inch- long sections of frame members.



- E. Cutaway Sample: Corner of security window, made from 12-inch lengths of full-size components, and showing details of the following:
  - 1. Joinery.
  - 2. Anchorage.
  - 3. Glazing.
  - 4. Flashing and drainage.
- F. Qualification Data: For qualified Installer and testing agency.
- G. Welding certificates.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of security window and accessory indicated as ballistics resistant.
- I. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.
- J. Warranty: Sample of special warranty.
- K. Other Informational Submittals:
  - 1. Examination reports documenting inspections of substrates, areas, and conditions.
  - 2. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
- B. Testing Agency Qualifications: Qualified according to ASTM E 699 and experienced in ballistics-resistance testing.
- C. Source Limitations: Obtain security windows from single source from single manufacturer.
- D. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
- E. Preinstallation Conference: Conduct conference at Project site.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.
- B. Label security window packaging with location in Project and drawing designation.
- C. Store crated security windows on raised blocks to prevent moisture damage.



## 1.7 PROJECT CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## 1.8 COORDINATION

- A. Coordinate installation of anchorages for security windows. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

## 1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including deflections exceeding 1/4 inch.
    - b. Failure of welds.
    - c. Excessive air leakage.
    - d. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
  - 2. Warranty Period: Three years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B.
- D. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 240/A 240M or ASTM A 666, austenitic stainless steel, Type 304, stretcher-leveled standard of flatness.
- E. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.
- F. Embedded Plate Anchors: Fabricated from steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch- diameter, headed studs welded to back of plate.
- G. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- H. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.



- I. Sealants: For sealants required within fabricated security windows, provide type recommended by manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating.

## 2.2 WINDOW COMPONENTS

- A. Glazing: Manufacturer's standard factory-installed ballistics resistant glazing that complies with requirements of UL listing for ballistics-resistance level.
- B. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
- C. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers, and with a proven record of compatibility with surfaces contacted in installation.
  - 1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
  - 2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
  - 3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
  - 4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- D. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressure indicated.

## 2.3 FIXED, TRANSACTION SECURITY WINDOWS

- A. Fixed, Transaction Security Windows: Provide fixed, framed transaction windows with operable sash or ventilator capable of allowing transfer of currency and documents.
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Chicago Bullet Proof Systems.
    - b. Diebold, Incorporated.
    - c. Krieger Specialty Products Company.
    - d. National Bullet Proof, Inc.
- B. Configuration: As indicated on Drawings.
- C. Ballistics Resistance: Level 3 when tested according to UL 752.





- D. Framing: Fabricate perimeter framing, mullions, and glazing stops from metal sheet as follows:
  - 1. Material: Cold-rolled steel sheet, with baked-enamel finish.
  - 2. Profile: Manufacturer's standard with minimum face dimension indicated.
  - 3. Minimum Face Dimension: 2 inches.
  - 4. Framing Depth:
    - a. As indicated on Drawings.
- E. Head and Jamb Framing: Designed for sealant glazing.
- F. Channel-Frame Sill: Formed from stainless steel and designed for sealant glazing.

## 2.4 ACCESSORIES

- A. Recessed, Nonricochet Deal Trays: Formed from stainless steel; fabricated with recessed bullet trap to ricochet bullets away from secure side, with exposed flanges for recessed installation into horizontal surface, and with sliding stainless-steel cover.
  - 1. Clear Opening Size: 12 inches wide by 11 inches deep by 1-1/2 inches high.
  - 2. Bullet Trap Location: Secure side.
  - 3. Ballistics Resistance: Same as security window .
  - 4. Listed and labeled as bullet resisting according to UL 752.
- B. Speaking Apertures: Fabricate from stainless steel, designed to allow passage of speech at normal speaking volume without distortion.
  - 1. Shape: Circular.
  - 2. Ballistics Resistance: Same as security window.
  - 3. Listed and labeled as bullet resisting according to UL 752.

## 2.5 FABRICATION

- A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
  - 1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.
  - 2. Prepare security windows for glazing unless preglazing at the factory is indicated.
- B. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
  - 1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.
- C. Glazing Stops: Finish glazing stops to match security window framing.
  - 1. Secure-Side (Exterior) Glazing Stops: Welded or integral to framing.
  - 2. Nonsecure-Side (Interior) Glazing Stops: Removable, coordinated with glazing indicated.



- D. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- E. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
- F. Factory-cut openings in glazing for speaking apertures.
- G. Preglazed Fabrication: Preglaze window units at factory, where required for applications indicated. Comply with requirements in Division 08 Section "Security Glazing."

## 2.6 METALLIC-COATED STEEL SHEET FINISHES

- A. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and apply galvanizing repair paint, complying with SSPC-Paint 20, to comply with ASTM A 780.
- B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard 2-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 1 mil for topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
  - 1. Color and Gloss: As selected by Architect from manufacturer's full range.

## 2.7 STAINLESS-STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
  - 1. Run grain of directional finishes with long dimension of each piece.
  - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
  - 3. Directional Satin Finish: No. 4.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.



- B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.
- D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
  - 1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
  - 2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.
- E. For glazing materials whose orientation is critical for performance, verify installation orientation.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordination: Furnish layouts for cast-in-place anchors, clips, and other security window anchors whose installation is specified in other Sections.

### 3.3 INSTALLATION

- A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing security windows to in-place construction. Include threaded fasteners for masonry inserts, security fasteners, and other connectors.
  - 1. Install an attached or integral flange to secure side of security windows extending over rough-in opening gap so that gap has same ballistics-resistance performance as security window.
- B. Glazed Framing: Provide sealant-glazed framing. Comply with installation requirements in Division 08 Section "Security Glazing."
- C. Removable Glazing Stops and Trim: Fasten components with security fasteners.
- D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.
- E. Sealants: Comply with requirements in Division 07 Section "Joint Sealants" for installing sealants, fillers, and gaskets.
  - 1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
  - 2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.



- F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

#### 3.4 ADJUSTING

- A. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

#### 3.5 CLEANING AND PROTECTION

- A. Clean surfaces promptly after installation of security windows. Take care to avoid damaging the finish. Remove excess glazing and sealant compounds, dirt, and other substances.
- B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Division 08 Section "Security Glazing" for cleaning and maintenance.
- C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

END OF SECTION



## SECTION 08 71 00

### DOOR HARDWARE

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hardware for wood and aluminum doors.
  - 2. Key cabinets.
- B. Related Requirements:
  - 1. Section 08 12 13.13 - Standard Hollow Metal Frames: Silencers integral with steel frames.
  - 2. Section 08 14 16 - Flush Wood Doors: Solid and hollow-core flush wood doors.
  - 3. Section 08 41 13 - Aluminum-Framed Entrances and Storefronts: Door hardware except cylinders.
  - 4. Section 26 05 19 - Low-Voltage Electrical Power Conductors and Cables: Power supply to electric hardware devices.

##### 1.2 REFERENCE STANDARDS

- A. Builders Hardware Manufacturers Association:
  - 1. ANSI/BHMA Certified Products Directory.
  - 2. ANSI/BHMA A156.1 - Butts and Hinges.
  - 3. ANSI/BHMA A156.2 - Bored & Preassembled Locks and Latches.
  - 4. ANSI/BHMA A156.3 - Exit Devices.
  - 5. ANSI/BHMA A156.4 - Door Controls - Closers.
  - 6. ANSI/BHMA A156.5 - Cylinders and Input Devices for Locks.
  - 7. ANSI/BHMA A156.6 - Architectural Door Trim.
  - 8. ANSI/BHMA A156.7 - Template Hinge Dimensions.
  - 9. ANSI/BHMA A156.8 - Door Controls - Overhead Stops and Holders.
  - 10. ANSI/BHMA A156.12 - Interconnected Locks & Latches.
  - 11. ANSI/BHMA A156.13 - Mortise Locks.
  - 12. ANSI/BHMA A156.14 - Sliding and Folding Door Hardware.
  - 13. ANSI/BHMA A156.15 - Release Devices.
  - 14. ANSI/BHMA A156.16 - Auxiliary Hardware.
  - 15. ANSI/BHMA A156.17 - Self Closing Hinges.
  - 16. ANSI/BHMA A156.18 - Materials and Finishes.
  - 17. ANSI/BHMA A156.19 - Power Assist & Low Energy Power Operated Doors.
  - 18. ANSI/BHMA A156.21 - Thresholds.
  - 19. ANSI/BHMA A156.22 - Door Gasketing and Edge Seal Systems.
  - 20. ANSI/BHMA A156.23 - Electromagnetic Locks.
  - 21. ANSI/BHMA A156.24 - Delayed Egress Locks.
  - 22. ANSI/BHMA A156.25 - Electrified Locking Devices.



- B. NFPA:
  - 1. NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
  - 2. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies.

- C. UL:
  - 1. UL - Building Materials Directory.
  - 2. UL 10B - Standard for Fire Tests of Door Assemblies.
  - 3. UL 305 - Standard for Panic Hardware.

### 1.3 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.
- B. Coordinate Work of this Section with other directly affected Sections involving manufacture or fabrication of internal reinforcement for door hardware and recessed items.
- C. Templates: Furnish templates or physical hardware items to door and frame manufacturers sufficiently in advance to avoid delay in Work.
- D. Coordinate mounting heights with door and frame manufacturers.
- E. Sequence installation to accommodate required utility connections.
- F. Coordinate Owner's keying requirements during course of Work.
- G. Reinforcing Units: Furnished by door and frame manufacturers; coordinated by hardware supplier or hardware manufacturer.

### 1.4 PREINSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this Section.
- C. Include persons involved with installation of doors, frames, and hardware.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer information.
- C. Shop Drawings:
  - 1. Indicate locations and mounting heights of each type of hardware.
  - 2. Submit schedules, templates, and manufacturer's parts lists.
  - 3. Submit wiring diagrams including system descriptions for electrical hardware, point-to-point and riser diagrams, and function statements.



- D. Finish Hardware List:
  - 1. Designate items of hardware furnished for each opening or place of installation, identified by floor name or number and door number as used in door schedule on Drawings.
  - 2. Show door number and location, handing, door and frame material, manufacturer and catalog numbers, finishes, and keying information.
  - 3. Explain abbreviations.
- E. Samples:
  - 1. Submit two samples of typical hinges, latchset, lockset, and closers, illustrating style, color, and finish.
  - 2. Approved samples may be incorporated into Work.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer Instructions: Submit special procedures and perimeter conditions requiring special attention.
- H. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.
- I. Qualifications Statements:
  - 1. Submit qualifications for manufacturer and supplier.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.
- B. Project Record Documents: Record actual locations of installed cylinders and their master key code.
- C. Operation and Maintenance Data: Submit manufacturer information regarding operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
- D. Keys: Deliver with identifying tags to Owner by secure shipment direct from supplier.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
  - 1. Furnish 10 extra key lock cylinders for each master keyed group.
- C. Tools: Furnish special wrenches and tools applicable for each different and special hardware component.



## 1.8 QUALITY ASSURANCE

- A. Perform Work according to:
  - 1. ANSI/BHMA A156 series.
  - 2. NFPA 80.
  - 3. UL 305.
- B. Furnish hardware marked and listed in BHMA Certified Products Directory.
- C. Products Requiring Electrical Connection:
  - 1. Listed and classified by UL or testing firm acceptable to authority having jurisdiction as suitable for indicated purpose.
  - 2. Coordination:
    - a. Prior to electrically controlled and operated hardware being ordered, coordinate electrical requirements with other trades in writing.
    - b. Check Shop Drawings of such other Work to ensure that adequate provisions are being made for proper location and installation of hardware.

## 1.9 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.
- B. Supplier:
  - 1. Company specializing in supplying commercial door hardware as specified in this Section, with minimum five years' documented experience and approved by primary hardware manufacturers.
  - 2. Personnel: Architectural Hardware Consultant (AHC) qualified person.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Inspection: Accept materials on Site in manufacturer's original packaging and inspect for damage.
- C. Handling:
  - 1. Package hardware items individually with necessary fasteners, instructions, and installation templates.
  - 2. Label and identify each package with door opening code to match hardware schedule.
- D. Store materials according to manufacturer instructions.
- E. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.





## 1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for locksets and door closers.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Fire-Rated Openings:
  - 1. Provide door hardware UL listed, WH listed, or listed by other testing laboratory approved by applicable authorities.
  - 2. Hardware Testing: Comply with NFPA 252.

### 2.2 DOOR HARDWARE

- A. Hinges:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Ives
    - b. McKinney
  - 2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
  - 3. Description:
    - a. Type: Full mortise.
    - b. Comply with ANSI/BHMA A156.1 , A156.7, and A156.17.
    - c. Widths: Sufficient to clear trim projection when door swings 180 degrees.
    - d. Minimum Quantity per Door Leaf:
      - 1) Doors 90 Inches High: Three hinges.
      - 2) Doors 120 Inches High: Four hinges.
      - 3) Fire-Rated Doors 86 Inches High: Three hinges.
  - 4. Size and Weight:
    - a. 1-3/4-Inch Doors: 4-1/2 inches, heavyweight.
  - 5. Pins:
    - a. Type: Nonferrous and nonremovable.
    - b. Location: Exterior and locked out-swinging doors.
    - c. Furnish nonrising pins for interior doors.
  - 6. Tips: Flat button, with matching plug.
- B. Locksets:
  - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Sargent
    - b. Schlage
  - 2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
  - 3. Description:
    - a. Compatible with specified cylinders.



- b. Typical Backset: 2-3/4 inches.
    - c. Strikes:
      - 1) Standard, with extended lips to protect trim from being marred by latchbolt.
  - 4. Mortise Locksets: Comply with ANSI/BHMA A156.13, Series 1000, Grade 1.
- C. Exit Devices:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Sargent
    - b. Von Duprin
  - 2. Substitutions: As specified in Section 01 60 00 - Product Requirement.
  - 3. Description:
    - a. Suitable for doors requiring exit devices.
    - b. Type: Concealed vertical rod, with crossbar.
    - c. Comply with ANSI/BHMA A156.3, Grade 1.
    - d. Strikes:
      - 1) Standard, with extended lips to protect trim from being marred by latchbolt.
      - 2) Furnish dustproof floor strikes.
  - 4. Coordinators: Overhead concealed-in-frame type at pairs of doors.
- D. Electric Strikes:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Von Duprin
  - 2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
  - 3. Electric Strikes:
    - a. Comply with ANSI/BHMA A156.5 and A156.19.
    - b. Mounting: Mortised.
- E. Cylinders:
- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Medeco
  - 2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
  - 3. Description: Match existing building cylinders.
  - 4. Keying:
    - a. To existing keying system.
    - b. Furnish construction keying.
  - 5. Keys:
    - a. Material: Nickel-silver.
    - b. Stamp keys with "DO NOT DUPLICATE."
    - c. Minimum Quantities:
      - 1) Master Keys: Five.



- 2) Grand Master Keys: Three.
- 3) Great-Grand Master Keys: Three.
- 4) Construction Keys: Three.
- 5) Control Keys: Three with 10 extra cylinder cores.
- 6) Change Keys: Two for each lock.

F. Closers:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Sargent
  - b. LCN
2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
3. Description:
  - a. Type: Modern, with cover.
  - b. Comply with ANSI/BHMA A156.4.
  - c. Mounting: Surface.
  - d. Operation: Full rack and pinion, with steel spring and nonfreezing hydraulic fluid.
  - e. Required for fire-rated doors.
4. Adjustability: Furnish controls for regulating closing, latching, speeds, and back checking.
5. Arms:
  - a. Type: To suit individual condition.
  - b. Furnish parallel-arm closers at reverse-bevel doors and where doors swing full 180 degrees.
6. Location:
  - a. Exterior Doors: Inside of door.
  - b. Interior Doors: Room side of door.
  - c. Other Doors: Pull side of door.
7. Maximum Operating Pressure:
  - a. Interior Doors: 5 lbf.
  - b. Exterior Doors: 10 lbf .
  - c. Fire-Rated Doors: 15 lbf.

G. Door Controls and Overhead Holders:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Horton
2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
3. Power Door Operators:
  - a. Comply with ANSI/BHMA A156.19.
  - b. Power-Assist Type: Furnish power mechanism which reduces opening resistance of self-closing door.
  - c. Low-Energy Type: Furnish power mechanism which opens and closes door upon receipt of signal.



- d. Low-Energy Power Open Type:
  - 1) Furnish power mechanism which opens self-closing door.
  - 2) Door closes independent of power operator.

H. Manual and Automatic Bolts, Protection Plates, Thresholds, and Trim:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - a. Rockwood
  - b. Burns
  - c. Ives
- 2. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- 3. Description: Furnish as indicated in Schedule, with accessories as required for complete operational door installations.
- 4. Manual and Automatic Constant Latching Bolts:
  - a. Description: Top and bottom flush bolts, with dustproof floor strike.
  - b. Comply with ANSI/BHMA A156.16, Grade 1.
- 5. Kickplates:
  - a. Comply with ANSI/BHMA A156.6.
  - b. Height: As indicated on hardware schedule.
  - c. Width: 1 inch less than door width.
  - d. Material:
    - 1) Stainless steel.
    - 2) Thickness: Minimum 0.050 inch.
- 6. Weatherstripping: Continuous at top and sides of exterior doors.
  - a. Comply with ANSI/BHMA A156.21.
- 7. Thresholds: Maximum height of 1/2 inch.
  - a. Comply with ANSI/BHMA A156.21.
- 8. Wall Stops:
  - a. Size: 3 inches.
  - b. Description: Convex pad with no visible screws.
  - c. Comply with ANSI/BHMA A156.1, Grade 1.
- 9. Floor Stops:
  - a. Description: Dome type.

## 2.3 FINISHES

A. Finishes:

- 1. Comply with ANSI/BHMA A156.18.
- 2. Hinges:
  - a. Satin Finish: Comply with BHMA 630 and 626.
- 3. Typical Exterior Exposed and High Use Interior Door Hardware:
  - a. Satin-Finished Stainless Steel: Comply with BHMA 630.
- 4. Typical Interior Door Hardware:
  - a. Satin-Finished Stainless Steel: Comply with BHMA 630.
- 5. Typical Interior Door Hardware:
  - a. Satin-Finished Stainless Steel: Comply with BHMA 630.



6. Closers:
  - a. Clear Anodized Satin Aluminum: Comply with BHMA 628.
  - b. Primed for Painting: Comply with BHMA 600.
7. Thresholds:
  - a. Finish appearance to match door hardware on exterior face of door.
8. Other Items: Furnish manufacturer's standard finishes to match similar hardware types on same door, and maintain acceptable finish considering anticipated use and BHMA category of finish.

## 2.4 ACCESSORIES

- A. Lock Trim: Furnish levers with as selected from manufacturer's full range of levers and roses.
- B. Through Bolts:
  1. Do not permit through bolts and grommet-nuts on door faces in occupied areas unless no alternative is possible.
  2. Do not use through bolts on solid-wood core doors.
- C. Key Cabinet:
  1. Description:
    - a. Material: Sheet steel.
    - b. Door: Piano hinged.
    - c. Lock: Cylinder-type, master keyed to building system.
  2. Size: Accommodate Project keys plus sufficient room to allow for 10 percent growth.
  3. Hook Labeling: Horizontal metal strips, with clear plastic strip cover over labels.
  4. Finish:
    - a. Baked enamel with manufacturer's standard finish.
    - b. Color: as selected.
- D. Fasteners:
  1. As recommended by hardware manufacturer and as required to secure hardware.
  2. Finish: Match hardware item being fastened.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify that doors and frames are ready to receive door hardware.
- C. Verify that dimensions are as indicated on Shop Drawings.
- D. Verify that electric power is available to power-operated devices and is of correct characteristics.



### 3.2 INSTALLATION

- A. According to manufacturer instructions.
- B. Mounting Heights from Finished Floor to Center Line of Hardware Item:
  - 1. Comply with manufacturer recommendations and applicable codes, if not otherwise indicated.
  - 2. Locksets: 38 inches.
  - 3. Crossbar-Type Exit Devices: 38 inches.
  - 4. Top Hinge: Jamb manufacturer's standard, but not greater than 10 inches from head of frame to centerline of hinge.
  - 5. Bottom Hinge: Jamb manufacturer's standard, but not greater than 12-1/2 inches from floor to centerline of hinge.
  - 6. Intermediate Hinges: Equally spaced between top and bottom hinges and from each other.
  - 7. Hinge Mortise on Door Leaf: 1/4 inch to 5/16 inch from stop side of door.

### 3.3 FIELD QUALITY CONTROL

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for testing, adjusting, and balancing.
- B. Inspection: Primary hardware manufacturer's representatives will inspect installation and certify that hardware and installation has been furnished and installed according to manufacturer instructions and as specified.

### 3.4 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for starting and adjusting.
- B. Adjust hardware for smooth operation.

### 3.5 PROTECTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not permit adjacent Work to damage hardware or hardware finish.

END OF SECTION



## SECTION 09 21 16

### GYPSUM BOARD ASSEMBLIES

#### PART 1 - GENERAL

##### 1.1 SECTION REQUIREMENTS

- A. Submittals: Project Data.
- B. Fire-Resistance-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
- C. STC-Rated Assemblies: Provide materials and construction identical to those tested in assemblies per ASTM E 90 and classified per ASTM E 413 by a qualified independent testing and inspecting agency.

#### PART 2 - PRODUCTS

##### 2.1 PANEL PRODUCTS

- A. Provide in maximum lengths available to minimize end-to-end butt joints.
- B. Gypsum Wallboard: ASTM C 36, in thickness indicated, with manufacturer's standard edges. Regular type, unless otherwise indicated Type X where indicated, Sag-resistant type for ceiling surfaces.
- C. Water-Resistant Gypsum Backing board: ASTM C 630, in thickness indicated. Regular type, unless otherwise indicated.
- D. Cementitious Backer Units: ANSI A118.9.

##### 2.2 ACCESSORIES

- A. Trim Accessories: ASTM C 1047, formed from galvanized or aluminum-coated steel sheet, rolled zinc, or plastic.
  - 1. Provide cornerbead at outside corners, unless otherwise indicated.
  - 2. Provide LC-bead (J-bead) at exposed panel edges.
  - 3. Provide control joints where indicated.
- B. Joint-Treatment Materials: ASTM C 475.
  - 1. Joint Tape: Paper, unless otherwise recommended by panel manufacturer.
  - 2. Joint Compounds: Drying-type, ready-mixed, all-purpose compounds.
  - 3. Cementitious Backer Unit Joint-Treatment Materials: Projects recommended by cementitious backer unit manufacturer.



- C. Acoustic Sealant: Non-hardening, non-skinning, for use in conjunction with gypsum board; for exposed and concealed joints: nonsag, paintable, nonstaining latex sealant complying with ASTM C 834.
- D. Sound-Attenuation Blankets: ASTM C 665, Type I (unfaced).
- E. Miscellaneous Materials: Auxiliary materials for gypsum board construction that comply with referenced standards.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify site conditions are ready to receive work and opening dimensions are as indicated on shop drawings.

### 3.2 DEMOLITION

- A. Extend existing gypsum board installations using materials and methods as specified.
- B. Repair and remodel existing gypsum board assemblies which remain or are to be altered.

### 3.3 INSTALLATION

- A. Install and finish gypsum panels to comply with ASTM C 840 and GA-216.
  - 1. Isolate gypsum board assemblies from abutting structural and masonry work. Provide edge trim and acoustic sealant.
  - 2. Single-Layer Fastening Methods: Fasten gypsum panels to support with screws.
  - 3. Multilayer Fastening Methods: Fasten base layers and face layer separately to supports with screws.
- B. STC-Rated Assemblies: Comply with ASTM C 919 for location of edge trim and closing off sound flanking paths around or through gypsum board assemblies.
- C. Furring For Ceilings as required on drawings.
- D. Fire-Resistance-Rated Assemblies: Comply with the requirements of listed assemblies.
- E. Finishing Gypsum Board Assemblies:
  - 1. Unless otherwise indicated, provide Level 4 finish: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges.
  - 2. At concealed areas, unless a higher level of finish is required for fire-resistance-rated assemblies, provide Level 1 finish: Embed tape at joints.
  - 3. Install ceiling framing independent of walls, columns, and above ceiling work.[





### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation of Finished Gypsum Board Surface from Flat Surface: 1/8 inch in 10 feet.

END OF SECTION



## SECTION 09 51 13

### ACOUSTICAL PANEL CEILINGS

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Acoustic tile.
  - 2. Acoustic panels.
  - 3. Metal pans.
  - 4. Suspended metal grid ceiling system and perimeter trim.
  - 5. Supplementary acoustic insulation over system units.
- B. Related Requirements:
  - 1. Section 07 21 16 - Blanket Insulation.
  - 2. Section 07 90 00 - Joint Protection.
  - 3. Section 08 31 13 - Access Doors and Frames: Access panels.
  - 4. Section 23 37 00 - Air Outlets and Inlets: Air diffusion devices in ceiling system.
  - 5. Section 26 51 00 - Interior Lighting: Light fixtures in ceiling system.
  - 6. Section 27 51 16 - Public Address and Mass Notification Systems: Speakers in ceiling system.
  - 7. Section 28 31 00 - Fire Detection and Alarm: Fire alarm components in ceiling system.

##### 1.2 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM C635 - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
  - 2. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
  - 3. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
  - 4. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
  - 5. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
  - 6. ASTM E580/E580M - Standard Practice for Application of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Requiring Seismic Restraint.
  - 7. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- B. American Society of Civil Engineers:
  - 1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures.



- C. Ceilings and Interior Systems Construction Association:
  - 1. CISCA - Acoustical Ceilings: Use and Practice.
- D. National Fire Protection Association:
  - 1. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- E. Underwriters Laboratories Inc.:
  - 1. UL - Fire Resistance Directory.

### 1.3 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene a minimum of one week prior to commencing work of this section.

### 1.4 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Sequence Work to ensure acoustic ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- C. Install acoustic units after interior wet work is dry.

### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit data on metal grid system components, acoustic units and acoustic insulation.
- C. Shop Drawings:
  - 1. Indicate grid layout and related dimensioning, junctions with other work or ceiling finishes, interrelation of mechanical and electrical items related to. Indicate method of suspension where interference exists.
  - 2. Indicate installation details required for seismic design loads.
- D. Samples:
  - 1. Submit cutsheet illustrating material and finish of acoustic units.
  - 2. Submit cutsheet of suspension system main runner,] [cross runner, and perimeter molding,
- E. Manufacturer's Instructions: Submit special procedures, and perimeter conditions requiring special attention.



## 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Extra Stock Materials:
  - 1. Furnish five percent of total acoustic unit area of extra tile to Owner.

## 1.7 QUALITY ASSURANCE

- A. Conform to Cisca requirements.
- B. Surface Burning Characteristics: Comply with the following when tested in accordance with NFPA 286.
  - 1. During 40 kW Exposure: No flame spread to ceiling.
  - 2. During 160 kW Exposure: No flame spread to perimeter of tested sample and no flashover.
  - 3. Total Smoke Release: Maximum 1,000 cu m.
- C. Perform Work in accordance with Connor, Maine.
- D. Maintain one copy of each document on site.

## 1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum three years documented experience.

## 1.9 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Ambient conditions control facilities for product storage and installation.
- B. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustic unit installation.

# PART 2 - PRODUCTS

## 2.1 SUSPENDED ACOUSTICAL CEILINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Armstrong World Industries
  - 2. USG Interiors, Inc. Subsidiary of USG Corporation
  - 3. CertainTeed Corporation



- B. Substitutions: Section 01 60 00 - Product Requirements.

## 2.2 COMPONENTS

- A. Acoustic Tile: ASTM E1264, conforming to the following:
  - 1. Size: 24 inches x 24inches.
  - 2. Thickness: 5/8 inches.
  - 3. Composition: Mineral
  - 4. Light Reflectance: not less than 0.83.
  - 5. NRC: Not less than 0.50.
  - 6. CAC: Not less than 35.
  - 7. Edge: Square
  - 8. Surface Color: As selected from manufacturer's full range.
  - 9. Surface Finish: Lightly textured, embossed.
- B. Grid:
  - 1. Non-fire Rated Grid: ASTM C635, intermediate duty; exposed T; components die cut and interlocking.
  - 2. Grid Materials: Commercial quality cold rolled steel with galvanized coating.
  - 3. Exposed Grid Surface Width: 15/16 inch with reveal.
  - 4. Perimeter Molding Width: Match grid width.
  - 5. Accessories: Stabilizer bars, clips, splices, perimeter moldings, hold down clips, required for suspended grid system and as required by applicable code for seismic design category.
  - 6. Support Channels and Hangers: Galvanized steel; size and type to suit application, and ceiling system flatness requirement specified.

## 2.3 ACCESSORIES

- A. Acoustic Batt Insulation: Specified in Section 07 21 16, unfaced; 2 inch thick.
- B. Gasket For Perimeter Moldings: Closed cell rubber sponge tape.
- C. Touch-up paint is required when field cutting and exposing edges of tegular acoustic units.
- D. Touch-up Paint: Type and color to match acoustic and grid units.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for installation examination.
- B. Verify layout of hangers will not interfere with other work.



### 3.2 DEMOLITION

- A. Extend existing acoustical ceiling installations using materials and methods as specified.
- B. Clean and repair existing acoustical ceilings which remain or are to be reinstalled.

### 3.3 INSTALLATION

- A. Lay-In Grid Suspension System:
  - 1. Install suspension system in accordance with ASTM C635, ASTM C636 and as supplemented in this section.
  - 2. Install suspension system in accordance with ASTM E580/E580M and CISCA for Seismic Zone 0-2.
  - 3. Locate system on room axis according to reflected plan.
  - 4. Install after major above ceiling work is complete. Coordinate location of hangers with other work.
  - 5. Install hanger clips during steel deck erection. Install additional hangers and inserts as required.
  - 6. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
  - 7. Where ducts or other equipment prevent regular spacing of hangers, reinforce nearest affected hangers and related carrying channels to span extra distance.
  - 8. Do not support components on main runners or cross runners when weight causes total dead load to exceed deflection capability. Support fixture loads by supplementary hangers located within 6 inches of each corner; or support components independently.
  - 9. Do not eccentrically load system, or produce rotation of runners.
  - 10. Perimeter Molding:
    - a. Install edge molding at intersection of ceiling and vertical surfaces with continuous gasket.
    - b. Use longest practical lengths.
    - c. Mitercorners.
    - d. Install at junctions with other interruptions.
  - 11. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.
- B. Acoustic Units:
  - 1. Fit acoustic units in place, free from damaged edges or other defects detrimental to appearance and function.
  - 2. Lay directional patterned units in basket weave pattern. Fit border trim neatly against abutting surfaces.
  - 3. Install units after above ceiling work is complete.
  - 4. Install acoustic units level, in uniform plane, and free from twist, warp, and dents.
  - 5. Cutting Acoustic Units:
    - a. Cut to fit irregular grid and perimeter edge trim.
    - b. Cut square reveal edges to field cut units.



- c. Double cut and field paint exposed edges of tegular units.
6. Where round obstructions occur, install preformed closures to match perimeter molding.
7. Lay acoustic insulation for distance of [48] inches on both sides of acoustic partitions as indicated on Drawings.
8. Install hold-down clips to retain panels tight to grid system within 20 of exterior door.

### 3.4 TOLERANCES

- A. Section 01 40 00 - Quality Requirements: Tolerances.
- B. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet .
- C. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION



## SECTION 09 65 00

### RESILIENT FLOORING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes resilient sheet flooring; resilient tile flooring; resilient base; and resilient stair accessories.
- B. Related Sections:
  - 1. Section 03 54 00 - Cast Underlayment.

##### 1.2 REFERENCES

- A. ASTM International:
  - 1. ASTM F1066 - Standard Specification for Vinyl Composition Floor Tile.
  - 2. ASTM F1303 - Standard Specification for Sheet Vinyl Floor Covering with Backing.
  - 3. ASTM F1344 - Standard Specification for Rubber Floor Tile.
  - 4. ASTM F1700 - Standard Specification for Solid Vinyl Floor Tile.
  - 5. ASTM F1861 - Standard Specification for Resilient Wall Base.
- B. Federal Specification Unit:
  - 1. FS L-F-475 - Floor Covering Vinyl, Surface (Tile and Roll), with Backing.
  - 2. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant.
- C. National Fire Protection Association:
  - 1. NFPA 253 - Standard Method of Test for Critical Radiant Flux for Floor Covering Systems Using a Radiant Heat Energy Source.
- D. Scientific Certification Systems:
  - 1. SCS EC10.2 - Environmental Certification Program Indoor Air Quality Performance.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate seaming plan, custom patterns and inlay designs.
- C. Product Data: Submit data describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- D. Samples:
  - 1. Submit manufacturer's complete set of color chart for initial selection.
  - 2. Submit two samples, illustrating color and pattern for each resilient flooring product specified.





#### 1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning, stripping, and re-waxing.

#### 1.5 QUALITY ASSURANCE

- A. Surface Burning Characteristics:
  - 1. Floor Finishes Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
  - 2. Base Material: Class I, minimum 0.45 watts/sq cm when tested in accordance with NFPA 253.
- B. Perform Work in accordance with Maine, Municipality of Connor Include the following paragraph only when the cost of acquiring specified standards is justified.
- C. Maintain one copy of each document on site.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Protect roll materials from damage by storing per manufacturer recommendations.

#### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Maintain temperature in storage area between 55 degrees F and 90 degrees F .
- C. Store materials for not less than 48 hours prior to installation in area of installation at temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F .

#### 1.9 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.



- B. Furnish 10 percent of installed materials of flooring, 10 percent of installed stair materials of base of each type and color specified.

## PART 2 - PRODUCTS

### 2.1 TILE FLOORING

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Armstrong Flooring
  - 2. Tarkett Commercial
  - 3. Altro Quartz
- B. Substitutions: Section 01 60 00 - Product Requirements

### 2.2 RESILIENT BASE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Roppe
  - 2. Tarkett Commercial
  - 3. Armstrong Flooring
- B. Substitutions: Section 01 60 00 - Product Requirements

### 2.3 ACCESSORIES

- A. Subfloor Filler: Type recommended by adhesive material manufacturer.
- B. Primers and Adhesives: Waterproof; types recommended by flooring manufacturer.
- C. Sealer and Wax: Types recommended by flooring manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify concrete floors are dry to maximum moisture content as recommended by manufacturer and exhibit negative alkalinity, carbonization, and dusting.
- C. Verify floor and lower wall surfaces are free of substances capable of impairing adhesion of new adhesive and finish materials.



### 3.2 PREPARATION

- A. Remove sub-floor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with sub-floor filler to achieve smooth, flat, hard surface.
- B. Prohibit traffic until filler is cured.
- C. Clean substrate.
- D. Apply primer as required to prevent "bleed-thru" or interference with adhesion by substances cannot be removed.

### 3.3 EXISTING WORK

- A. Extend existing resilient flooring installations using materials and methods compatible with existing installations, or as specified.
- B. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- C. Install edge strips at unprotected or exposed edges, where flooring terminates, and where indicated. Secure resilient strips by adhesive.
- D. Install coved base as detailed on drawings, using coved base filler as backing at floor to wall junction.
- E. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- F. Install flooring in recessed floor access covers. Maintain floor pattern.

### 3.4 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical tile pattern.
- C. Install tile to straight set pattern. Allow a minimum 1/2 full size tile width at room or area perimeter.
- D. Scribe flooring to walls, columns, cabinets, floor outlets, and other appurtenances to produce tight joints.
- E. Where floor finishes are different on opposite sides of door, terminate flooring under centerline of door.
- F. Install flooring in recessed floor access covers. Maintain floor pattern.



### 3.5 INSTALLATION - BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, 'V' cut back of base strip to 2/3 of its thickness and fold. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Remove excess adhesive from floor, base, and wall surfaces without damage.
- C. Clean, seal, and maintain resilient flooring products.

### 3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Prohibit traffic on resilient flooring for 48 hours after installation.

### 3.8 SCHEDULE

- A. Vestibule:
  - 1. Type: VCT.
  - 2. Style: Marble.
  - 3. Color/pattern: Architect to select from range currently available from manufacturer.
- B. Admin Office /Front Office:
  - 1. Type: VCT.
  - 2. Style: Marble.
  - 3. Color/pattern: Architect to select from range currently available from manufacturer.
- C. Breakroom:
  - 1. Type: VCT.
  - 2. Style: Marble.
  - 3. Color/pattern: Architect to select from range currently available from manufacturer.

END OF SECTION



## SECTION 09 90 00

### PAINTING AND COATING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes: Surface preparation and field application of paints, stains, varnishes, and other coatings.
- B. Related Requirements:
  - 1. Section 32 17 23 - Pavement markings.

##### 1.2 DEFINITIONS

- A. Refer to ASTM D16 for definitions of terms used in this Section.

##### 1.3 REFERENCE STANDARDS

- A. ASTM International:
  - 1. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications.
  - 2. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials.
  - 3. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. Master Painters Institute:
  - 1. MPI - Approved Products List.
  - 2. MPI - Architectural Painting Manual.
- C. Section 01 30 00 - Administrative Requirements: Requirements for preinstallation meeting.
- D. Convene minimum one week prior to commencing Work of this Section.

##### 1.4 SEQUENCING

- A. Section 01 10 00 - Summary: Requirements for sequencing.
- B. Do not apply finish coats until paintable sealant is applied.
- C. Back prime wood trim before installation of trim.

##### 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data:



1. Submit manufacturer data on finishing products and special coatings.
2. Include MPI - Approved Products Lists with proposed products highlighted.

C. Samples:

1. Painted Samples:
  - a. Submit two painted samples, illustrating selected colors and sheens for each selected color and system with specified coats cascaded.
  - b. Submit on tempered hardboard, 8 by 10 inches in size.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Manufacturer Instructions: Submit special surface preparation procedures, substrate conditions requiring special attention.

F. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

G. Qualifications Statements:

1. Submit qualifications for manufacturer and applicator.
2. Submit manufacturer's approval of applicator.

#### 1.6 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for submittals.

B. Operation and Maintenance Data: Submit information on cleaning, touchup, and repair of painted and coated surfaces.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Extra Stock Materials:

1. Furnish 1 gal. of each color and type as provided for Project.
2. Label each container with manufacturer's label, color, type, room numbers.
3. Store where directed by Owner.

#### 1.8 QUALITY ASSURANCE

A. MPI Standards:

1. Comply with indicated MPI standards.
2. Products: Listed in MPI - Approved Products List.

B. Maintain one copy of each standard affecting Work of this Section on Site.

#### 1.9 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.



- B. Applicator: Company specializing in performing Work of this Section with minimum three years' documented experience.
- C. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- D. Container Labeling: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- E. Inspection:
  - 1. Accept materials on Site in manufacturer's sealed and labeled containers.
  - 2. Inspect for damage and to verify acceptability.
- F. Store materials in ventilated area and otherwise according to manufacturer instructions.
- G. Protection:
  - 1. Protect materials from moisture and dust by storing in clean, dry location remote from construction operations areas.
  - 2. Provide additional protection according to manufacturer instructions.

#### 1.10 AMBIENT CONDITIONS

- A. Section 01 50 00 - Temporary Facilities and Controls: Requirements for ambient condition control facilities for product storage and installation.
- B. Storage Conditions:
  - 1. Minimum Ambient Temperature: 45 degrees F.
  - 2. Maximum Ambient Temperature: 90 degrees F.
- C. Application Conditions:
  - 1. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint manufacturer.
  - 2. Do not apply exterior coatings during rain or snow, when relative humidity is outside humidity ranges, or when moisture content of surfaces exceeds those required by paint manufacturer.
  - 3. Minimum Application Temperatures for Latex Paints: 45 degrees F for interiors and 50 degrees F for exteriors, unless otherwise indicated by manufacturer instructions.
  - 4. Minimum Application Temperature for Polyurethane Finishes: 65 degrees F for interiors and exteriors, unless otherwise indicated by manufacturer instructions.
  - 5. Lighting Level: 80> fc, measured mid-height at substrate surface.

#### 1.11 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for warranties.
- B. Furnish five-year manufacturer's warranty for paint and coatings.



## PART 2 - PRODUCTS

### 2.1 APPLICATORS

- A. Applicator List:
  - 1. Sprayer.
  - 2. Roller.
  - 3. Brush.

### 2.2 PAINTS AND COATINGS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Sherwin Williams.
  - 2. Benjamin Moore.
  - 3. Pratt and Lambert.
- B. Substitutions: As specified in Section 01 60 00 - Product Requirements.
- C. Materials:
  - 1. Coatings:
    - a. Ready mixed, except field-catalyzed coatings.
    - b. Capable of drying or curing free of streaks or sags.
  - 2. Patching Materials: Latexfiller.
  - 3. Fastener Head Cover Materials: Latexfiller.
  - 4. Accessories:
    - a. Grade: Commercial.
    - b. Linseed oil.
    - c. Turpentine.
    - d. Paint thinners.
    - e. Other materials not specifically indicated but required to achieve specified finishes.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application examination.
- B. Verify that surfaces are ready to receive Work as recommended by product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of Work, and report conditions capable of affecting proper application to Architect/Engineer.
- D. Test shop-applied primer for compatibility with subsequent cover materials.





- E. Moisture Content:
  - 1. Measure moisture content of surfaces using electronic moisture meter.
  - 2. Do not apply finishes unless moisture content of surfaces are below following maximums:
    - a. Plaster and Gypsum Wallboard: 12percent.
    - b. Masonry, Concrete, and Concrete Unit Masonry: 12percent.
    - c. Interior Wood: 15percent, measured according to ASTM D4442.
    - d. Exterior Wood: 15percent, measured according to ASTM D4442.

### 3.2 PREPARATION

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for application preparation.
- B. Prepare coatings as follows:
  - 1. To soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
  - 2. For smooth flow and brushing properties.
- C. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
- D. Defects:
  - 1. Correct defects and clean surfaces capable of affecting Work of this Section.
  - 2. Remove or repair existing coatings exhibiting surface defects.
- E. Marks: Seal marks that may bleed through surface finishes with shellac.
- F. Impervious Surfaces:
  - 1. Remove mildew by scrubbing with solution of tetra-sodium phosphate and bleach.
  - 2. Rinse with clean water and allow surface to dry.
- G. Aluminum Surfaces Scheduled for Paint Finish:
  - 1. Remove surface contamination by steam or high-pressure water.
  - 2. Remove oxidation with acid etch and solvent washing.
  - 3. Apply etching primer immediately following cleaning.
- H. Asphalt, Creosote, or Bituminous Surfaces Scheduled for Paint Finish:
  - 1. Remove foreign particles to permit adhesion of finishing materials.
  - 2. Apply latex-based sealer or primer.
  - 3. Allow to dry.
- I. Gypsum Board Surfaces:
  - 1. Fill minor defects with filler compound.
  - 2. Spot-prime defects after repair.
- J. Concrete and Unit Masonry Surfaces Scheduled to Receive Paint Finish:



1. Remove dirt, loose mortar, scale, salt or alkali powder, and other foreign matter.
  2. Remove oil and grease with solution of tri-sodium phosphate, rinse well, and allow to dry.
  3. Remove stains caused by weathering of corroding metals with solution of sodium metasilicate after thoroughly wetting with water, and allow to dry.
- K. Plaster Surfaces:
1. Fill hairline cracks, small holes, and imperfections with latex patching plaster.
  2. Make smooth and flush with adjacent surfaces.
  3. Wash and neutralize high-alkali surfaces.
- L. Uncoated Steel and Iron Surfaces:
1. Remove grease, mill scale, weld splatter, dirt, and rust.
  2. If heavy coatings of scale are evident, remove by hand power tool wire brushing or by sandblasting.
  3. Clean by washing with solvent.
  4. Apply treatment of phosphoric acid solution, ensuring that weld joints, bolts, and nuts are similarly cleaned.
  5. Spot-prime paint after repairs.
- M. Shop-Primed Steel Surfaces:
1. Sand and scrape to remove loose primer and rust.
  2. Feather edges to make touch-up patches inconspicuous.
  3. Clean surfaces with solvent.
  4. Prime bare steel surfaces.
- N. Interior Wood Items Scheduled to Receive Paint Finish:
1. Wipe off dust and grit prior to priming.
  2. Seal knots, pitch streaks, and sappy sections with sealer.
  3. Fill nail holes and cracks after primer has dried.
  4. Sand between coats.
- O. Interior Wood Items Scheduled to Receive Transparent Finish:
1. Wipe off dust and grit prior to sealing.
  2. Seal knots, pitch streaks, and sappy sections with sealer.
  3. Fill nail holes and cracks after sealer has dried.
  4. Sand lightly between coats.
- P. Exterior Wood Scheduled to Receive Paint Finish:
1. Remove dust, grit, and foreign matter.
  2. Seal knots, pitch streaks, and sappy sections.
  3. Fill nail holes with tinted exterior paintable calking compound after prime coat has been applied.
- Q. Exterior Wood Scheduled to Receive Transparent Finish:
1. Remove dust, grit, and foreign matter.
  2. Seal knots, pitch streaks, and sappy sections with sealer.
  3. Fill nail holes with tinted exterior calking compound after sealer has been applied.



- R. Glued-Laminated Beams: Prior to finishing, wash surfaces with solvent, and remove grease and dirt.
- S. Wood Doors Scheduled for Painting: Seal wood door top and bottom edge surfaces with tinted primer.
- T. Metal Doors Scheduled for Painting: Prime metal door at top and bottom edge surfaces.
- U. Existing Work:
  - 1. Extend existing paint and coatings installations using materials and methods compatible with existing installations and as specified.

### 3.3 APPLICATION

- A. Comply with MPI - Architectural Painting Manual.
- B. Do not apply finishes to surfaces that are not dry.
- C. Apply each coat to uniform appearance.
- D. Apply each coat of paint slightly darker than preceding coat, unless specified otherwise.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Cleaning:
  - 1. Vacuum surfaces to remove loose particles.
  - 2. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Fillers:
  - 1. If clear finishes are required, tint fillers to match wood.
  - 2. Work fillers into grain before set, and wipe excess from surface.
- H. Concealed Surfaces:
  - 1. Prime concealed surfaces of interior and exterior woodwork with primer paint.
  - 2. Prime concealed surfaces of interior wood surfaces scheduled to receive stain or varnish finish with gloss varnish reduced 25 percent with thinner.

### 3.4 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Requirements for inspecting and testing.

### 3.5 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Requirements for cleaning.
- B. Collect waste material that may constitute fire hazards, place in closed metal containers, and remove daily from Site.



### 3.6 ATTACHMENTS

- A. Schedule - Shop-Primed Items for Site Finishing:
- B. Schedule - Exterior Surfaces:
  - 1. Wood - Painted (Opaque):
    - a. Latex System MPI EXT 6.3L:
      - 1) Prime Coat: Primer, latex for exterior wood, MPI #6.
      - 2) Intermediate Coat: Matching topcoat.
      - 3) Topcoat: Latex, exterior, low sheen (MPI Gloss Level 3-4), MPI #15.
      - 4) Topcoat: Latex, exterior semigloss (MPI Gloss Level 5), MPI #11.
  - 2. Steel - Shop Primed:
    - a. Touch up with zinc chromate zinc rich primer.
    - b. Two coats of alkyd latex enamel, gloss semigloss.
    - c. Per Architect's selection from full range of colors by manufacturer.
- C. Schedule - Interior Surfaces:
  - 1. Wood - Transparent:
    - a. Polyurethane Varnish over Stain System MPI INT 6.3E:
      - 1) Stain Coat: Stain, semitransparent, for interior wood, MPI #90; as manufactured by Minwax.
      - 2) First Intermediate Coat: Matching topcoat.
      - 3) Second Intermediate Coat: Matching topcoat.
      - 4) Topcoat: Varnish, interior, polyurethane, oil-modified, gloss (MPI Gloss Level 6) , MPI #56.
  - 2. Concrete Block:
    - a. Institutional Low-Odor/VOC Latex System MPI INT 4.2E:
      - 1) Block Filler: Block filler, latex, interior/exterior, MPI #4.
      - 2) Intermediate Coat: Matching topcoat.
      - 3) Topcoat: Latex, interior, institutional low odor/VOC, flat (MPI Gloss Level 1), MPI #143
      - 4) Topcoat: Alkyd, interior, flat (MPI Gloss Level 1) , MPI #49.
    - b. Touch up with latex primer.
    - c. Two coats of latex enamel, semigloss.
    - d. Per Architect's selection from full range of colors by manufacturer.
  - 3. Gypsum Board and Plaster Walls:
    - a. One coat of latex primer sealer.
    - b. Two coats of latex enamel, semigloss.
    - c. Per Architect's selection from full range of colors by manufacturer.
  - 4. Gypsum Board and Plaster Ceilings:
    - a. One coat of latex primer sealer.
    - b. Two coats of latex enamel, flat.
    - c. Per Architect's selection from full range of colors by manufacturer.
- D. Schedule - Colors:
  - 1. Vestibule/ Lobby:
    - a. Walls: Per Architect's selection from full range of colors by manufacturer.



2. Admin Office/ Front Office:
  - a. Walls: Per Architect's selection from full range of colors by manufacturer.
3. Break Room:
  - a. Walls: Per Architect's selection from full range of colors by manufacturer.

END OF SECTION



## SECTION 12 35 30

### RESIDENTIAL CASEWORK

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes cabinets and counter tops; vanity cabinets and counter tops; and casework hardware.
- B. Related Sections:
  - 1. Section 06 10 00 - Rough Carpentry: Grounds and support framing.
  - 2. Section 06 20 00 - Finish Carpentry: Related trim not specified in this section.
  - 3. Section 06 41 00 - Architectural Wood Casework: Wood casework.
- C. Allowances: Include under provisions of Section 012000 - Price and Payment Procedures: Allowances. Allowance includes purchase and delivery of casework. Installation is included in this section and is part of Contract Sum/Price
- D. REFERENCES
- E. American National Standards Institute:
  - 1. ANSI A156.9 - Cabinet Hardware.
  - 2. ANSI A161.1 - Performance and Construction Standard for Kitchen and Vanity Cabinets.
- F. Forest Stewardship Council:
  - 1. FSC Guidelines - Forest Stewardship Council Guidelines.
- G. Kitchen Cabinet Manufacturers Association:
  - 1. KCMA - Directory of Certified Cabinet Manufacturers.

##### 1.2 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Shop Drawings: Indicate casework locations, scale plans, elevations, , clearances required and
- C. Product Data: Submit component dimensions, configurations, and construction details. Include the following paragraph for submission of physical samples for selection of finish, color, texture, and other properties.
- D. Samples: Submit two samples, minimum size 3 x 6 inches of each color of finish and cutsheets of each type of hardware.



### 1.3 SUSTAINABLE DESIGN SUBMITTALS

### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with ANSI A161.1 and KCMA certification.
- B. Perform Work in accordance with State of Maine, and Connor Municipality.
- C. Maintain one copy of each document on site.

### 1.5 QUALIFICATIONS

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

## PART 2 - PRODUCTS

### 2.1 SUSTAINABILITY CHARACTERISTICS

### 2.2 CASEWORK

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Schrock Cabinets  
Dreamline
  - 2. Saco Industries
- B. Substitutions: Section 01 60 00 - Product Requirements.

### 2.3 COMPONENTS

- A. Cabinet Construction: 1/2" Plywood construction
- B. Counter Top: Post formed plastic laminate over particle board, square internal intersection to back splash
- C. Side Splash: Plastic laminate over particle board, square internal intersections to back splash and top surface
- D. Door and Drawer Fronts: Thermally Fused Laminate over particle board.
- E. Bolts, Nuts, Washers and Screws: Of size and type to suit application.
- F. Concealed Joint Fasteners: Threaded steel.

### 2.4 HARDWARE COMPONENTS

- A. Hardware: Manufacturer's standard.



## 2.5 FABRICATION

- A. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- B. Fabricate corners and joints without gaps or inaccessible spaces or areas where dirt or moisture could accumulate.
- C. Fabricate each unit rigid, not dependent on building structure or adjacent units for rigidity.
- D. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
- E. Form edges smooth. Form material for counter tops, facing, and shelves from continuous sheets.
- F. Provide cutouts for plumbing fixtures. Prime paint contact surfaces of cut edges.
- G. When necessary to cut and fit on site, furnish materials with ample allowance for cutting. Furnish trim for scribing and site cutting.

## 2.6 SHOP FINISHING

- A. Exposed To View Surfaces: Thermally Fused laminate of Architect's choice from manufacturer's full range of options.

# PART 3 - EXECUTION

## 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify adequacy of support framing.

## 3.2 INSTALLATION

- A. Install casework, components and accessories.
- B. Use anchoring devices to suit conditions and substrate materials encountered.
- C. Set casework items plumb and square, securely anchored to building structure.
- D. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Use filler strips; not additional overlay trim for this purpose.
- E. Close ends of units, back splashes, shelves and bases.





### 3.3 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust doors, drawers, hardware, fixtures, and other moving or operating parts to function smoothly.

### 3.4 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean casework, counters, shelves, and hardware.

### 3.5 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit finished casework to be exposed to continued construction activity.

### 3.6 SCHEDULES

- A. Kitchen: Casework module of 24 inches, post formed counter tops, thermally fused laminate exterior finish; melamine finished cabinet interior.

END OF SECTION



## SECTION 12 48 13

### ENTRANCE FLOOR MATS AND FRAMES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes carpet mat; link mat; and rubber mat;.

##### 1.2 REFERENCES

- A. Carpet and Rug Institute:
  - 1. CRI Green Label Plus Testing Program.

##### 1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal requirements.
- B. Product Data: Submit data indicating mat characteristics and component dimensions,.

##### 1.4 QUALITY ASSURANCE

- A. Maintain one copy of each document on site.

#### PART 2 - PRODUCTS

##### 2.1 FLOOR MATS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated in the work include, but are not limited to the following:
  - 1. Uline
  - 2. Amarco Products
  - 3. American Floor Mats
- B. Substitutions: Section 01 60 00 - Product Requirements.

##### 2.2 COMPONENTS

- A. Carpet Mat: Cut nylon pile permanently bonded to rubber backing; 72 inch wide x 144 inch long with one inch (25 mm) black matching rubber edge border; black color.

##### 2.3 FABRICATION

- A. Construct recessed mat frames square, tight joints at corners, rigid. Coat surfaces with protective coating where in contact with cementitious materials.
- B. Fabricate mats in single unit sizes.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.

### 3.2 INSTALLATION

- A. Include this article for recessed mats only.

### 3.3 INSTALLATION

- A. Install mats surface applied after cleaning of finish flooring.

### 3.4 SCHEDULES

- A. Mat Schedule:
  - 1. Vestibule:
    - a. Type: Carpet Mat.
    - b. Size: 72 by 144 inches
    - c. Color: Black.

END OF SECTION



## SECTION 22 00 00

### BASIC PLUMBING REQUIREMENTS

#### 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 specifies the basic requirements for mechanical installations and warranty period maintenance, and includes requirements common to more than one section. It expands and supplements the requirements specified in sections of Division 1.
- B. Related Sections include the following:
  - 1. Section 22 05 53 - Plumbing Identification.

##### 1.3 DEFINITIONS

- A. Complete and Operational System: A Plumbing system that has been installed, tested, cleaned, signed-off by appropriate Authority and made operational. Completion of Owner training to be part of this requirement.
- B. Plumbing Contractor: The project Contractor responsible for the installation of the Plumbing systems and equipment. This designation refers to the Contractor who performs the Plumbing work.

##### 1.4 SUBMITTALS

- A. General: See Division 1 for general submittal and product substitution requirements.
- B. Pre-Construction Submittals: Submit the following items prior to commencing with installations.
  - 1. Coordination Drawings.
  - 2. Schedule of Plumbing Submittals and Closeout Procedures.
- C. During Construction: Submit at earliest possible date but not later than 50% completion of plumbing work as determined by schedule of values.
  - 1. Operation and Maintenance Manual Table of Contents.
  - 2. Schedule of Plumbing Submittals and Closeout Procedures with updated current status information.
  - 3. A detailed service plan including a complete itemization of maintenance tasks required to fulfill each equipment manufacturer's warranty requirements for every piece of plumbing equipment included in the Work of this project. Organize tasks by Specification Section. Identify frequency for performance of each task. Coordinate preparation of plan with plumbing equipment manufacturer's written O&M manuals and the requirements of applicable contract specification sections.



- a. The approved service plan including proposed date(s) for service task performance, and a resume for primary service technician(s) proposed to provide normal services.
- D. Post Construction: Submit the following at least fifteen (15) days before requesting site review for Substantial Completion.
1. Project Record Documents; as-builts.
  2. Operation and Maintenance manuals.
  3. Warranties.
  4. Completed Schedule of Plumbing Submittals and Closeout Procedures.

## 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: All work shall be performed by qualified journeymen of their respective trades who are employed by a firm that can demonstrate successful experience with work similar in type, quality and extent to the work required by this project.

## 1.6 BASIS OF PLUMBING DESIGNS

- A. General: The following information is intended to provide an overview of the intent and operation of the project Plumbing systems. It is not intended that each and every project Plumbing scope item be captured herein. The absence of a specific item or system in the descriptions below does not absolve the Plumbing Contractor(s) from providing the work identified by other Sections and the Drawings.
1. The Plumbing Contractor(s) shall provide a complete and operational systems and installations.
- B. Plumbing Systems Description:
1. The following systems shall be installed/renovated:
    - a. Domestic cold and hot water.
    - b. Sanitary waste, vent and indirect waste.
    - c. Trap primers.
  2. Systems Description:
    - a. Domestic water supply is existing, contractor shall connect into existing piping as shown on contract documents.
    - b. Domestic hot water is produced by two existing domestic water heaters, one of which shall be removed and replaced.
      - i. Hot water for general use shall be distributed and circulated at 120°F. Hot water shall be mixed down with a master-mixing valve at the water heater.
    - c. The domestic cold-water system shall be designed for a maximum velocity of 8 fps design flow. The domestic hot and recirculated hot water systems shall be designed for a maximum velocity of 4 fps design flow.
    - d. Domestic water make-up supply to potentially hazardous uses will be through RPZ type backflow preventers.
    - e. Floor drains shall require pressure-drop actuated trap priming valves, all bronze construction, no springs or plastic parts.



## 1.7 CODES, STANDARDS AND AUTHORITIES

- A. General: The following listing is intended to identify the major Codes, Standards, and Authorities Having Jurisdiction, (AHJ's) for the project. This information is at least partially provided on the P-000 series Drawings as well. In the event that there is a discrepancy between the information contained herein and that on the P-000 Drawings, the information herein shall govern.
  - 1. In the event that an item is included on the P-000 Drawings and is not listed herein, compliance with the requirements of said item is required.
  - 2. The exclusion of an applicable Code, Standard, or AHJ in the list below does not absolve the Contractor from meeting the requirements of said Code, Standard or AHJ.
- B. Codes: Work performed on the project must comply with the requirements of the following Codes:
  - 1. 2021 Uniform Plumbing Code.
  - 2. 2018 International Building Code.
  - 3. 2018 Mechanical Code of Maine.
- C. Standards: Work performed on the project must comply with the requirements of the following Industry Standards:
  - 1. NFPA National Fire Protection Association.
  - 2. UL Underwriters' Laboratories, Inc.
  - 3. NEMA National Electrical Manufacturer's Association.
  - 4. NEC National Electrical Code.
  - 5. ASME American Society of Mechanical Engineers.
  - 6. ASPE American Society of Plumbing Engineers.
  - 7. ANSI American National Standards Institute.
  - 8. AGA American Gas Association.
  - 9. OSHA Occupational Safety and Health Act.
  - 10. AWWA American Water Works Association.
  - 11. CISPI Cast Iron Soil Pipe Institute.
- D. Authorities Having Jurisdiction: Work performed on the project must comply with the requirements of the following AHJ's:
  - 1. Local Code Enforcement.
  - 2. State of Maine Plumbing Inspector.
  - 3. State of Maine Fire Marshall.

## 1.8 DRAWINGS AND SPECIFICATIONS

- A. General: The drawings and specifications are complimentary.
  - 1. What is shown or noted on the drawings, but not mentioned in the specifications, automatically becomes a part of the specifications.
  - 2. What is noted in the specifications, but not shown on the drawings, automatically becomes a part of the drawings.
  - 3. Conflicts between the requirements of the drawings and the specifications must be brought to the immediate attention of the Architect/Engineer.
    - a. The more stringent requirement will apply, unless ruled otherwise by the Architect/Engineer.



- b. When conflicts or discrepancies are noted, no work shall proceed until the conflict or discrepancy has been resolved by the Architect/Engineer.
  - B. Plumbing Drawings and Division 22 Specification Sections: The Plumbing Contractor shall bear the responsibility of determining full extent of work required by Contract Documents. The Plumbing Contractor shall refer to site, architectural, structural, mechanical, electrical and other Drawings and Specification Sections that indicate types of construction with which work of this Section must be coordinated. The Plumbing Contractor shall review the work with the General Contractor / Construction Manager to establish the extent of work for their trade, and to determine whether there will be any interference with the work of other trades. If the work is later found to include work required to complete and coordinate the work or another trade, or to interfere with the work of another trade then the changes required to complete the work or to eliminate the interference shall be made without additional cost to the Owner.
    - 1. The Drawings schematically indicate the order of connection of the various system components. Each and every nuance and detail is not indicated. Whether specifically shown or not, all items shall be connected in accordance with Code, the details provided, accepted trade practices, and the intent of the Contract Documents. Coordinate with the other trades.
  - C. Exact locations of ceiling mounted items shall be as shown and detailed on the Architectural reflected ceiling plans.
  - D. System components (thermostats, sensors, valves, access doors, etc.) are identified throughout the Drawings for proper system operation. If any component is inadvertently omitted from the drawings, provide that component as per a similar location.
  - E. Prepare a set of drawings in conjunction with the Fire Protection and HVAC Contractors. In the event that Plumbing and HVAC work is performed by separate Contractors, the HVAC Contractor shall take the lead and initiate the generation of the drawings. Plumbing and Fire Protection work shall be subsequently applied to the base drawings developed by the HVAC contractor.
    - 1. Drawings are intended to prevent installation conflicts.
    - 2. Drawings to indicate piping, ductwork, equipment and other system components in relation to each other, along with electrical fixtures, conduits, busses, cable trays, supports and structural members.
  - F. Drawing Requirements: Drawings to be generated at 3/8-inch = 1-foot minimum scale and shall be ultimately delivered on reproducible media. Drawing size to be consistent with the design drawings.
    - 1. Drawings to be CADD generated or manually drafted.
- 1.9 SUBSTITUTIONS
- A. General: See Division 1 for product substitution requirements.
    - 1. No substitute materials or equipment shall be incorporated in the work without the written approval of the Architect/Engineer.
  - B. Substitute materials and equipment submitted for approval must fit within the spaces available with neither substantial alteration nor increased pressure drops or friction losses.



- C. Approval of substitute materials or equipment by the Architect/Engineer shall not relieve the contractor from his responsibility to provide a complete and operational plumbing system.
- D. The Architect/Engineer's decision as to the equality or acceptability of proposed substitutions for the materials and equipment specified shall be final.
  - 1. Any additional costs incurred by such substitutions, including additional costs to other trades, or engineering design costs, shall be borne by the Contractor. This includes costs associated with the design and installation of infrastructure and support systems to facilitate a proposed substitution. This cost will be borne by the Plumbing Contractor.

#### 1.10 SCHEDULE OF PLUMBING SUBMITTALS AND CLOSEOUT PROCEDURES

- A. General: In conjunction with submittal scheduling requirements detailed in Section 01 33 00, prepare a separate Schedule of Plumbing Submittals and Closeout Procedures.
- B. Schedule shall list the following information for each required submittal:
  - 1. Specification Section number and title.
  - 2. Product Name or Description of Work Covered.
  - 3. Submittal Tracking Number.
  - 4. Required submission relative to construction:
    - a. Pre-construction (prior to fabrication/installation of product).
    - b. During construction.
    - c. Post-construction.
  - 5. Submittal Status:
    - a. NC: Final Approval Not Complete
    - b. A: Approved.
  - 6. Owner Training: Indicate if Owner Training is required.
    - a. NC: Training not performed or not completed.
    - b. A: Approved/Training Completed.
  - 7. Spare Materials and Parts.

#### 1.11 PLUMBING SUBMITTALS

- A. General: Refer to Division 1 for submittal definitions, requirements and procedures.
- B. Submittal of shop drawings, certified performance data, and samples will be accepted only when submitted per Division 1. Data submitted from subcontractors and material suppliers directly to the Architect/Engineer will not be processed.
- C. Submittals for each plumbing trade shall be complete, including all items for which submission and approval is required, and each sheet containing performance data shall be clearly highlighted and marked for the appropriate model or type of equipment to be reviewed. Intended use shall be written on each submittal sheet for each different type of equipment or material to be reviewed (i.e., valves for domestic water or heating hot water, etc.). Incomplete or unmarked submittals **WILL BE RETURNED** to the Contractor without action.





- D. Submittals shall be organized by specification Section and shall be clearly labeled. Submittals for HVAC and Plumbing items covered by a “shared” mechanical specification Section, (i.e., hangers and supports, insulation) shall be separate and clearly labeled as to the trade intended.
  - 1. Unclear and/or mixed submittals will not be processed.
- E. When two or more items of the same material or equipment are required, (i.e., plumbing fixtures, pumps, water heaters and valves,) they shall be products of the same manufacturer insofar as possible.
  - 1. This does not apply to raw or bulk materials such as pipe and fittings, sheet metal, etc.

#### 1.12 RECORD DOCUMENTS

- A. General: Refer to Division 1 for requirements.
- B. As work progresses, mark Drawings to indicate revisions to piping and ductwork, size and location including locations dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; mains and branches of piping systems, with valves and control devices located and numbered; Change Orders; concealed control system devices.
- C. Mark specifications to indicate approved substitutions; Change Orders; actual equipment and materials used.
- D. At completion of work and prior to final request for payment, the Plumbing Subcontractor(s) shall submit a complete set of reproducible record drawings showing all systems as actually installed. Drawings submitted shall be in the following format:
  - 1. Neatly hand marked up copies of the design drawings.
  - 2. CADD generated.
    - a. Design Drawing files may be available as a starting point for CADD generated drawings. A release form will need to be signed to facilitate this.
  - 3. Valve Tags: Record drawings to include valve tag markers which correspond to the valve tag chart provided under the O&M Manual Section.

#### 1.13 OPERATION AND MAINTENANCE (O&M) MANUALS

- A. General: Refer to Division 1 for procedures and requirements for preparation and submittal of O&M Manuals.
- B. Table of Contents: Prepare Table of Contents of O&M Manual and submit in accordance with Section 1.4.
- C. Systems Descriptions: Provide description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of all replaceable parts.
- D. Operating Procedures: Provide manufacturer's printed data, including start-up, break-in, routine and normal operating instructions; regulation control, stopping, shut-down, and emergency instructions; and summer and winter operating instructions.



- E. Maintenance Procedures: Provide for routine preventive maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.
- F. Servicing Instructions: Provide instructions, lubrication charts and schedules.
- G. Product Data: Provide copies of all approved submittals.
- H. Valve Schedules: Include valve tag charts in the O&M Manuals. Valve tag charts are as per Section, "Plumbing Identification."

#### 1.14 OWNER TRAINING

- A. General: Refer to Division 1 for general requirements.

#### 1.15 WARRANTIES

- A. Refer to Division 1 for project requirements for warranties. Individual warranties are required for each item of power driven or other plumbing equipment having moving parts, and wherever else specified in Division 22.
  - 1. Submit the warranties specified in Division 22 in a vinyl covered, three ring binder, tabulated and indexed for easy reference.
- B. Provide complete warranty information for each item, to include date of commencement; duration; and the names, addresses, and telephone numbers and procedures for filing claims and obtaining warranty services.
- C. Duration of warranties shall be not less than one year from the date of substantial completion of the facility unless prior approval has been granted in writing by the Architect/Engineer. If the manufacturer's warranty expires less than one year from the date of substantial completion, that warranty service and replacement of parts shall be provided by the plumbing subcontractor at no cost to the Owner.

#### 1.16 DELIVERY, STORAGE AND HANDLING

- A. General: Refer to Division 1 for material procurement requirements.
- B. Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling.
- C. Store equipment and materials at the site unless off-site storage is authorized in writing. Protect stored equipment and materials from damage.
- D. Coordinate deliveries of plumbing materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations.



#### 1.17 ENERGY EFFICIENCY

- A. All equipment shall have minimum efficiency as described in ASHRAE Standard 90.1-2019. All equipment suppliers must be aware of the requirements and submitted equipment shall meet these minimum requirements.

#### 1.18 REFRIGERANTS AND OTHER HAZARDOUS MATERIALS

- A. The Plumbing Contractor shall be responsible for the capture, removal, and disposal of materials resulting from the Work.
  - 1. Comply with the requirements of applicable Codes, Standards and Authorities.

#### 1.19 DIVISION OF PLUMBING AND ELECTRICAL RESPONSIBILITY

- A. General: Line voltage switches, fused switches, outlets, motor starters, power wiring and fuses necessary to connect and operate all electrically powered equipment specified herein will be furnished and installed as a part of the total project. Coordinate work with Division 26. The intent is to have a complete and operational system. The Plumbing Contractor shall be responsible for furnishing and installing the equipment necessary to provide for the complete and operational system.
- B. Motor Starters: Where not specified in Division 22, shall be furnished and installed under Division 26.
- C. Power Wiring: Wiring for equipment shall be furnished and installed as specified under Division 26.
- D. Temperature Control Wiring: Wiring and interlocks shall be furnished and installed under Division 23.
- E. Disconnect Switches: Where not specified in Division 22, shall be furnished and installed under Division 26.

### PART 2 - PRODUCTS – NOT USED

### PART 3 - EXECUTION

#### 3.1 START UP AND TESTING

- A. General: Contractor shall provide all fuel for startup and testing of all equipment provided in this section. Refer to Division 1 for responsibility of electrical power.
- B. The Plumbing Contractor is responsible for startup of all equipment provided in Division 22 Sections.
- C. The Plumbing Contractor shall verify that systems are complete and operational before commencing with balancing work.
- D. Prior to balancing, ensure the following conditions:
  - 1. Systems are started and operating in a safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Service and balance valves are open.



- E. Power Outage Test: Entire control system and all plumbing equipment shall be run through a simulated site power outage with standby generator operation and shall regain standard operation sequences when normal power is restored.
- F. Owner Witness of Test: The Owner shall witness final power outage test. Entire control system and all plumbing equipment shall pass power outage test prior to Owner witness.

### 3.2 FUNCTIONAL TESTING AND COMMISSIONING

- A. General: The entirety of the Plumbing Equipment and Controls System shall be tested for functional performance for specified operation and control sequences.

### 3.3 FINAL CLEANING

- A. General: Refer to Division 1 for general requirements regarding final cleaning.
- B. Refer to Division 22 Section, “Testing, Adjusting and Balancing” for requirements of cleaning filters, strainers, and other plumbing systems prior to final acceptance.

END OF SECTION



## SECTION 22 05 17

### SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Sleeves.
  - 2. Stack-sleeve fittings.
  - 3. Sleeve-seal systems.
  - 4. Sleeve-seal fittings.
  - 5. Grout.
  - 6. Silicone sealants.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.

#### PART 2 - PRODUCTS

##### 2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

##### 2.2 STACK-SLEEVE FITTINGS

- A. Description: Manufactured, galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.



## 2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. CALPICO, Inc.
  - 3. Metraflex Company (The).
- B. Description:
  - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
  - 2. Designed to form a hydrostatic seal of 20 psig minimum.
  - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 4. Pressure Plates: Composite plastic.
  - 5. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, ASTM B633 of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.4 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, 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.

## PART 3 - EXECUTION

### 3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
  - 1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
  - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
  - 2. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level.
  - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.



1. Cut sleeves to length for mounting flush with both surfaces.
2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint.

E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

### 3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
  2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 07 62 00 "Sheet Metal Flashing and Trim."
  3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
  4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials.

### 3.3 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

### 3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.



- C. Prepare test and inspection reports.

### 3.5 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
  - 1. Exterior Concrete Walls above Grade:
    - a. Piping Smaller than NPS 6: Steel pipe sleeves.
  - 2. Exterior Concrete Walls below Grade:
    - a. Cast-iron pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 3. Concrete Slabs-on-Grade:
    - a. Steel pipe sleeves with sleeve-seal system.
      - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
  - 4. Concrete Slabs above Grade:
    - a. Steel pipe sleeves.
    - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  - 5. Interior Partitions:
    - a. Piping Smaller than NPS 6: Steel pipe sleeves.

END OF SECTION





## SECTION 22 05 18

### ESCUTCHEONS FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.
  - 2. Floor plates.

##### 1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

##### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.

#### PART 2 - PRODUCTS

##### 2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

##### 2.2 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping and Relocated Existing Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
    - b. Chrome-Plated Piping: One-piece cast brass with polished, chrome-plated finish.
    - c. Insulated Piping: One-piece stamped steel with spring clips with polished, chrome-plated finish.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces and Equipment Rooms: One-piece cast brass with rough-brass finish.
- C. Install floor plates for piping penetrations of equipment-room floors.
- D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
  - 1. New Piping: One-piece, floor plate.

### 3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION



## SECTION 22 05 19

### METERS AND GAGES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Liquid-in-glass thermometers.
2. Thermowells.
3. Pressure gages.
4. Gage attachments.
5. Test plugs.
6. Test-plug kits.

###### B. Related Requirements:

1. Section 22 11 19 - Domestic Water Piping Specialties for water meters.

##### 1.2 ACTION SUBMITTALS

###### A. Product Data: For each type of product.

##### 1.3 INFORMATIONAL SUBMITTALS

###### A. Product Certificates: For each type of meter and gage.

##### 1.4 CLOSEOUT SUBMITTALS

###### A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 LIQUID-IN-GLASS THERMOMETERS

###### A. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Palmer Wahl Instrumentation Group.
  - b. Trerice, H. O. Co.
  - c. Weiss Instruments, Inc.
  - d. Weksler Glass Thermometer Corp.
2. Standard: ASME B40.200.
3. Case: Cast aluminum 7-inch nominal size unless otherwise indicated.
4. Case Form: Adjustable angle unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue or red organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F and deg C.
7. Window: Glass.



8. Stem: Aluminum and of length to suit installation.
  - a. Design for Thermowell Installation: Bare stem.
9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus, or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

## 2.2 THERMOWELLS

- A. Thermowells:
  1. Standard: ASME B40.200.
  2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting of type, diameter, and length required to hold thermometer..
  3. Type: Stepped shank unless straight or tapered shank is indicated.
  4. Lagging Extension: Include on thermowells for insulated piping and tubing.
  5. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

## 2.3 PRESSURE GAGES

- A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ametek U.S. Gauge.
    - b. Ashcroft Inc.
    - c. Flo Fab Inc.
    - d. Palmer Wahl Instrumentation Group.
    - e. Terice, H. O. Co.
    - f. WATTS.
    - g. Weiss Instruments, Inc.
    - h. Weksler Glass Thermometer Corp.
  2. Standard: ASME B40.100.
  3. Case: Liquid-filled and Sealed type(s); cast aluminum or drawn steel; 4-1/2-inch nominal diameter.
  4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
  5. Pressure Connection: Brass, with NPS 1/4, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
  6. Movement: Mechanical, with link to pressure element and connection to pointer.
  7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi and kPa.
  8. Pointer: Dark-colored metal.
  9. Window: Glass.
  10. Ring: Stainless steel.
  11. Accuracy: Grade B, plus or minus 2 percent of middle half of scale range.

## 2.4 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/4, ASME B1.20.1 pipe threads and porous-metal-type surge-dampening device. Include extension for use on insulated piping.



- B. Valves: Brass or stainless steel needle, with NPS 1/4, ASME B1.20.1 pipe threads.

## 2.5 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Peterson Equipment Co., Inc.
  - 2. Sisco Manufacturing Company, Inc.
  - 3. Trerice, H. O. Co.
  - 4. WATTS.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: One or two self-sealing rubber valves.
  - 1. Insert material for air, water, oil or gas service at 20 to 200 deg. F shall be CR.
  - 2. Insert material for air or water service at minus 30 to plus 275 deg. F shall be EPDM.
- G. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
  - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
  - 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
  - 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch-diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
  - 4. Carrying case shall have formed instrument padding.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.



- F. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- G. Install valve and snubber in piping for each pressure gage for fluids.
- H. Install test plugs in piping tees.
- I. Install thermometers in the following locations:
  - 1. Inlet and outlet of each water heater.
  - 2. Inlets and outlets of each domestic water heat exchanger.
  - 3. Inlet and outlet of each domestic hot-water storage tank.
  - 4. Inlet and outlet of each remote domestic water chiller.
  - 5. Outlet of mixing valve if not supplied by the valve manufacturer.
- J. Install pressure gages in the following locations:
  - 1. Building water service entrance into building.
  - 2. Inlet and outlet of each pressure-reducing valve.
  - 3. Suction and discharge of each domestic water pump.
  - 4. Inlet and outlet of each gas regulator.

### 3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

### 3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

### 3.4 PRESSURE-GAGE SCALE-RANGE SCHEDULE

- A. Scale Range for Water Service Piping:
  - 1. 0 to 200 psi and 0 to 1400 kPa.
- B. Scale Range for Domestic Water Piping (downstream of water entrance):
  - 1. 0 to 100 psi and 0 to 600 kPa.

END OF SECTION



## SECTION 22 05 23

### GENERAL-DUTY VALVES FOR PLUMBING PIPING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the requirements for general-duty valves for domestic water and sewer systems.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, Common Work Results for Plumbing.

##### 1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
  - A112.14.1-2003 .....Backwater Valves
- C. American Society of Sanitary Engineering (ASSE):
  - 1001-2008 .....Performance Requirements for Atmospheric Type Vacuum Breakers
  - 1003-2009 .....Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems
  - 1011-2004 .....Performance Requirements for Hose Connection Vacuum Breakers
  - 1013-2011 .....Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Principle Fire Protection Backflow Preventers
  - 1015-2011 .....Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
  - 1017-2009 .....Performance Requirements for Temperature Actuated Mixing Valves for Hot Water Distribution Systems
  - 1020-2004 .....Performance Requirements for Pressure Vacuum Breaker Assembly
  - 1035-2008 .....Performance Requirements for Laboratory Faucet Backflow Preventers
  - 1069-2005 .....Performance Requirements for Automatic Temperature Control Mixing Valves
  - 1070-2004 .....Performance Requirements for Water Temperature Limiting Devices
  - 1071-2012 .....Performance Requirements for Temperature Actuated Mixing Valves for Plumbed Emergency Equipment



- D. American Society for Testing and Materials (ASTM):
  - A126-2004(R2009).....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
  - A276-2013a.....Standard Specification for Stainless Steel Bars and Shapes
  - A536-1984(R2009).....Standard Specification for Ductile Iron Castings
  - B62-2009.....Standard Specification for Composition Bronze or Ounce Metal Castings
  - B584-2013.....Standard Specification for Copper Alloy Sand Castings for General Applications
- E. International Code Council (ICC):
  - IPC-2012 .....International Plumbing Code
- F. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
  - SP-25-2008 .....Standard Marking Systems for Valves, Fittings, Flanges and Unions
  - SP-67-2011 .....Butterfly Valves
  - SP-70-2011 .....Gray Iron Gate Valves, Flanged and Threaded Ends
  - SP-71-2011 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends
  - SP-80-2013 .....Bronze Gate, Globe, Angle, and Check Valves
  - SP-85-2011 .....Gray Iron Globe & Angle Valves, Flanged and Threaded Ends
  - SP-110-2010 .....Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
- G. National Environmental Balancing Bureau (NEBB):
  - 7th Edition 2005 .....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
- H. NSF International (NSF):
  - 61-2012 .....Drinking Water System Components – Health Effects
  - 372-2011 .....Drinking Water System Components – Lead Content

### 1.3 SUBMITTALS

- A. Manufacturer's Literature and Data Including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
  - 1. Ball Valves.
  - 2. Gate Valves.
  - 3. Butterfly Valves.
  - 4. Balancing Valves.
  - 5. Check Valves.
  - 6. Globe Valves.
  - 7. Water Pressure Reducing Valves and Connections.
  - 8. Backwater Valves.
  - 9. Backflow Preventers.
  - 10. Chainwheels.
  - 11. Thermostatic Mixing Valves.





B. See Section 22 00 00, Basic Plumbing Requirements

#### 1.4 DELIVERY, STORAGE, AND HANDLING

A. Valves shall be prepared for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Valves shall be prepared for storage as follows:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature.

### PART 2 – PRODUCTS

#### 2.1 VALVES, GENERAL

A. Asbestos packing and gaskets are prohibited.

B. Bronze valves shall be made with dezincification resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc shall not be permitted.

C. All valves used to supply potable water shall meet the requirements of NSF 61 and NSF 372.

#### 2.2 SHUT-OFF VALVES

A. Cold, Hot and Re-circulating Hot Water:

1. DN50, 2 inches and smaller: Ball, MSS SP-110, Ball valve shall be full port three piece or two piece with a union design with adjustable stem package. Threaded stem designs are not allowed. The ball valve shall have a SWP rating of 150 psig and a CWP rating of 600 psig. The body material shall be Bronze ASTM B584, Alloy C844. The ends shall be non-lead solder.
2. Less than DN100 4 inches: Butterfly shall have an iron body with EPDM seal and aluminum bronze disc. The butterfly valve shall meet MSS SP-67, type I standard. The butterfly valve shall have a SWP rating of 200 psig. The valve design shall be lug type suitable for bidirectional dead-end service at rated pressure. The body material shall meet ASTM A536, ductile iron.
3. DN100 4 inches and larger:
  - a. Class 125, OS&Y, Cast Iron Gate Valve. The gate valve shall meet MSS SP-70 type I standard. The gate valve shall have a CWP rating of 1380 kPa (200 psig). The valve materials shall meet ASTM A126, grey iron with bolted bonnet, flanged ends, bronze trim, and positive-seal resilient solid wedge disc. The gate valve shall be gear operated for sizes under DN200 8 inches and crank operated for sizes DN200 8 inches and above.



- b. Single flange, ductile iron butterfly valves: The single flanged butterfly valve shall meet the MSS SP-67 standard. The butterfly valve shall have a CWP rating of 200 psig. The butterfly valve shall be lug type, suitable for bidirectional dead-end service at rated pressure without use of downstream flange. The body material shall comply with ASTM A536 ductile iron. The seat shall be EPDM with stainless steel disc and stem.
- c. Grooved end, ductile iron butterfly valves. The grooved butterfly valve shall meet the MSS SP-67 standard. The grooved butterfly valve shall have a CWP rating of 200 psig. The valve materials shall be epoxy coated ductile iron conforming to ASTM A536 with two piece stainless steel stem, Buna-N encapsulated ductile iron disc, and EPDM seal. The butterfly valve shall be gear operated.

## 2.3 BALANCING VALVES

- A. Hot Water Re-circulating, DN75 3 inches and smaller manual balancing valve shall be of bronze body, brass ball construction with glass and carbon filled TFE seat rings and designed for positive shutoff. The manual balancing valve shall have differential pressure read-out ports across the valve seat area. The read out ports shall be fitting with internal EPT inserts and check valves. The valve body shall have DN8 NPT 1/4 inch NPT tapped drain and purge port. The valves shall have memory stops that allow the valve to close for service and then reopened to set point without disturbing the balance position. All valves shall have calibrated nameplates to assure specific valve settings.

## 2.4 CHECK VALVES

- A. DN75 3 inches and smaller shall be Class 125, bronze swing check valves with non-metallic disc suitable for type of service. The check valve shall meet MSS SP-80 Type 4 standard. The check valve shall have a CWP rating of 200 psig. The check valve shall have a Y pattern horizontal body design with bronze body material conforming to ASTM B62, solder joints, and PTFE or TFE disc.

## 2.5 GLOBE VALVES

- A. DN75 3 inches or smaller: Class 150, bronze globe valve with non-metallic disc. The globe valve shall meet MSS SP-80, Type 2 standard. The globe valve shall have a CWP rating of 300 psig. The valve material shall be bronze with integral seal and union ring bonnet conforming to ASTM B62 with solder ends, copper-silicon bronze stem, PTFE or TFE disc, and malleable iron hand wheel.

## 2.6 WATER PRESSURE REDUCING VALVE AND CONNECTIONS

- A. DN75 3 inches or smaller: The pressure reducing valve shall consist of a bronze body and bell housing, a separate access cover for the plunger, and a bolt to adjust the downstream pressure. The pressure reducing valve shall meet ASSE 1003. The bronze bell housing and access cap shall be threaded to the body and shall not require the use of ferrous screws. The assembly shall be of the balanced piston design and shall reduce pressure in both flow and no flow conditions. The assembly shall be accessible for maintenance without having to remove the body from the line.



- B. The regulator shall have a tap for pressure gauge.
- C. The regulator shall have a temperature rating of 212 degrees F for hot water or hot water return service. Pressure regulators shall have accurate pressure regulation to  $\pm 1$  psig.
- D. Connections Valves and Strainers: Shut off valves shall be installed on each side of reducing valve and a bypass line equal in size to the regulator inlet pipe shall be installed with a normally closed globe valve. A strainer shall be installed on inlet side of, and same size as pressure reducing valve. A pressure gage shall be installed on the inlet and outlet of the valve.

## 2.7 BACKWATER VALVE

- A. The backwater valve shall have a cast iron body, automatic thermoplastic type valve seat and flapper suited for water service. The flapper shall be slightly open during periods of non-operation. The pressure reducing valve shall meet ASME A112.14.1. The cleanout shall be extended to the finish floor and fit with a threaded countersunk plug. A clamping device shall be included when the cleanout extends through the waterproofing membrane.
- B. When the backwater valve is installed greater than 24 inches below the finish floor elevation, a pit or manhole large enough for a repair person can enter to service the backwater valve shall be installed.

## 2.8 BACKFLOW PREVENTERS

- A. A backflow prevention assembly shall be installed at any point in the plumbing system where the potable water supply comes in contact with a potential source of contamination.
- B. The pipe applied, or integral atmospheric vacuum breaker shall be ASSE listed 1001. The main body shall be cast bronze. The seat disc shall be the elastomer type suited for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable. Atmospheric vacuum breakers shall be installed in the following applications.
  - 1. Hose bibs and sinks with threaded outlets.
  - 2. Showers (telephone/handheld type).
  - 3. All kitchen equipment, if not protected by air gap.
  - 4. Detergent system.
  - 5. Glassware washers.
  - 6. Service sinks (integral with faucet only).
- C. The hose connection vacuum breaker shall be ASSE listed 1011. The main body shall be cast brass with stainless steel working parts. The diaphragm and disc shall be the elastomer type suited for water service. The device shall permit the attachment of portable hoses to hose thread outlets. Hose connection vacuum breakers shall be installed in the following locations requiring non-continuous pressure:



1. Hose bibbs and wall hydrants.
- D. The pressure vacuum breaker shall be ASSE listed 1020. The main body shall be brass. The disc and O-ring seal shall be the elastomer type. The valve seat and disc float shall be the thermoplastic type. Tee handle or lever handle shut-off ball valves. Test cocks for testing and draining where freezing conditions occur. All materials shall be suitable for water service. The device shall be accessible for maintenance without removing the device from the service line. The installation shall not be in a concealed or inaccessible location or where the venting of water from the device during normal operation is deemed objectionable.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Valve interior shall be examined for cleanliness, freedom from foreign matter, and corrosion. Special packing materials shall be removed, such as blocks, used to prevent disc movement during shipping and handling.
- B. Valves shall be operated in positions from fully open to fully closed. Guides and seats shall be examined and made accessible by such operations.
- C. Threads on valve and mating pipe shall be examined for form and cleanliness.
- D. Mating flange faces shall be examined for conditions that might cause leakage. Bolting shall be checked for proper size, length, and material. Gaskets shall be verified for proper size and that its material composition is suitable for service and free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Valves shall be located for easy access and shall be provide with separate support. Valves shall be accessible with access doors when installed inside partitions or above hard ceilings.
- C. Valves shall be installed in horizontal piping with stem at or above center of pipe.
- D. Valves shall be installed in a position to allow full stem movement.
- E. Check valves shall be installed for proper direction of flow and as follows:
  1. Swing Check Valves: In horizontal position with hinge pin level and on top of valve.



- F. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction. Locate backflow preventers in same room as connected equipment or system.
  - 1. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
- G. Install pressure gages on outlet of backflow preventers.
- H. Do not install bypass piping around backflow preventers.

END OF SECTION



## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal hanger-shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Pipe-positioning systems.
  - 8. Equipment supports.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Environmental Product Declaration (EPD): For each product.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers.
  - 2. Metal framing systems.
  - 3. Fiberglass strut systems.
  - 4. Pipe stands.
  - 5. Equipment supports.
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers.
  - 2. Include design calculations for designing trapeze hangers.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.



## 1.5 QUALITY ASSURANCE

- A. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- B. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
  - 3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

### 2.2 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Galvanized Metallic Coatings: Pregalvanized, hot-dip galvanized, or electro-galvanized.
  - 3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  - 2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  - 3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe and Tube Hangers:
  - 1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  - 2. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.



### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, Type 59, shop- or field-fabricated pipe-support assembly, made from structural-carbon-steel shapes, with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

### 2.4 METAL FRAMING SYSTEMS

#### A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ABB, Electrification Business.
  - b. Cooper B-line; brand of Eaton, Electrical Sector.
  - c. Flex-Strut Inc.
  - d. G-Strut.
  - e. Unistrut; Atkore International.
  - f. Wesanco, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly, made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4, factory-fabricated components for field assembly.
4. Channels: Continuous slotted channel with inturned lips.
5. Channel Width: Selected for applicable load criteria.
6. Channel Nuts: Formed or stamped nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
7. Hanger Rods: Continuous-thread rod, nuts, and washer made of zinc-coated carbon steel or stainless steel.
8. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

### 2.5 THERMAL HANGER-SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carpenter & Paterson, Inc.
  2. National Pipe Hanger Corporation.
  3. Pipe Shields Inc.
  4. Piping Technology & Products, Inc.
  5. Rilco Manufacturing Co., Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with 100-psig or ASTM C552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.





- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.6 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Hilti, Inc.
    - b. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - c. MKT Fastening, LLC.
    - d. Simpson Strong-Tie Co., Inc.
- B. Mechanical-Expansion Anchors: Insert-wedge-type anchors, for use in hardened Portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cooper B-line; brand of Eaton, Electrical Sector.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - e. MKT Fastening, LLC.
  - 2. Indoor Applications: Zinc-coated or stainless steel.
  - 3. Outdoor Applications: Stainless steel.

## 2.7 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand:
  - 1. Description: Single base unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
    - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.
  - 3. Hardware: Galvanized steel or polycarbonate.
  - 4. Accessories: Protection pads.
- C. Single-Base, Single-Pipe Stand:
  - 1. Description: Single base with vertical and horizontal members, and pipe support, for roof installation without membrane protection.
  - 2. Base: Single, vulcanized rubber, molded polypropylene, or polycarbonate.
    - a. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 10 percent.



3. Vertical Members: Two galvanized or stainless-steel, continuous-thread, 1/2-inch rods.
4. Horizontal Member: Adjustable horizontal, galvanized or stainless-steel pipe support channels.
5. Pipe Supports: Roller, Strut clamps, Clevis hanger or Swivel hanger.
6. Hardware: Galvanized or Stainless-steel.
7. Accessories: Protection pads.
8. Height: 12 inches above roof.

- D. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

## 2.8 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.9 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-carbon-steel shapes.

## 2.10 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  1. Properties: Nonstaining, noncorrosive, and nongaseous.
  2. Design Mix: 5000-psi, 28-day compressive strength.

# PART 3 - EXECUTION

## 3.1 APPLICATION

- A. Hangers on insulated piping shall be sized to the insulation OD to ensure that insulation is continuous through the hanger.
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.
- 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.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size, or install intermediate supports for smaller-diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
  - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.



- K. 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.
- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms, and install reinforcing bars through openings at top of inserts.
- N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- P. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating Above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating Below Ambient Air Temperature: Use thermal hanger-shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39 protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal hanger-shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - 5. Thermal Hanger Shields: Install with insulation of same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment, and make bearing surface smooth.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.



### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections, so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.6 PAINTING

- A. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Division 9 Section "Painting".
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

### 3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finishes.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.



- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.



16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment of up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11 split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable-Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.



5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal Hanger-Shield Inserts: For supporting insulated pipe.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.





6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners instead of building attachments where required in concrete construction.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION



## SECTION 22 05 53

### IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Warning tape.
  - 4. Pipe labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Warning tags.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment-Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve-numbering scheme.
- E. Valve Schedules: For each piping system. Include in operation and maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.1 EQUIPMENT LABELS

- A. Metal Labels for Equipment:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Brady Corporation.
    - b. Kolbi Pipe Marker Co.
    - c. Seton Identification Products; a Brady Corporation company.
  - 2. Material and Thickness: Brass, 0.032-inch, stainless steel, 0.025-inch, aluminum, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 3. Letter and Background Color: As indicated for specific application under Part 3.
  - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.



5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
  6. Fasteners: Stainless steel rivets or self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
  8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

## 2.2 WARNING SIGNS AND LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Brady Corporation.
  2. National Marker Company.
  3. Seton Identification Products; a Brady Corporation company.
- B. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless steel rivets or self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- J. Label Content: Include caution and warning information plus emergency notification instructions.



## 2.3 WARNING TAPE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. National Marker Company.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. Material: Vinyl.
- C. Minimum Thickness: 0.005 inch.
- D. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- E. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- F. Maximum Temperature: 160 deg F.
- G. Minimum Width: 2 inches.

## 2.4 PIPE LABELS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Kolbi Pipe Marker Co.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover or cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- E. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- F. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
  - 1. Pipe size.
  - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
  - 3. Lettering Size: At least 1/2 inch for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.



## 2.5 VALVE TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Kolbi Pipe Marker Co.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire, beaded chain or S-hook.
- C. Letter and Background Color: As indicated for specific application under Part 3.
- D. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Include valve-tag schedule in operation and maintenance data.

## 2.6 WARNING TAGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation.
  - 2. Kolbi Pipe Marker Co.
  - 3. Seton Identification Products; a Brady Corporation company.
- B. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - 1. Size: 3 by 5-1/4 inches minimum.
  - 2. Fasteners: Brass grommet and wire.
  - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - 4. Letter and Background Color: As indicated for specific application under Part 3.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.



### 3.2 INSTALLATION, GENERAL REQUIREMENTS

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.
- D. Locate identifying devices so that they are readily visible from the point of normal approach.

### 3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
  - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where are-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.

### 3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

### 3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 09 90 00 "Painting and Coating."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, with painted, color-coded bands or rectangles on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:



1. Within 3 ft. of each valve and control device.
  2. At access doors, manholes, and similar access points that permit view of concealed piping.
  3. Within 3 ft. of equipment items and other points of origination and termination.
  4. Spaced at maximum intervals of 25 ft along each run. Reduce intervals to 10 ft. in areas of congested piping and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
1. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  2. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
  3. Domestic Hot-Water Return Piping: White letters on an ANSI Z535.1 safety-green background.
  4. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
  5. Nonpotable Cold Water: Black letters on an ANSI Z535.1 safety-yellow background.

### 3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
    - a. Domestic Cold Water: 1-1/2 inches, round.
    - b. Domestic Hot Water: 1-1/2 inches, round.
    - c. Domestic Hot-Water Return: 1-1/2 inches, round.
    - d. Nonpotable Cold Water: 1-1/2 inches, round.
  2. Valve-Tag Colors:
    - a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

### 3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.



- B. Attach warning tags, with proper message, to equipment and other items where scheduled.

END OF SECTION





## SECTION 22 05 93

### TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. TAB of domestic water system.
  - 2. TAB of plumbing equipment:
    - a. Domestic hot-water in-line circulation pumps.
    - b. Drainage pumps.
  - 3. Pipe-leakage test verification.
  - 4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

##### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB special the "Quality this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.
- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.



- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
  - 1. Instrument type and make.
  - 2. Serial number.
  - 3. Application.
  - 4. Dates of use.
  - 5. Dates of calibration.

## 1.5 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
  - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by NEBB:
  - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB.
  - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

## 1.6 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

## PART 2 - PRODUCTS (Not Applicable)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.



- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
  - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.
- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.2 PREPARATION

- A. Prepare a TAB plan that includes the following:
  - 1. Equipment and systems to be tested.
  - 2. Strategies and step-by-step procedures for balancing the systems.
  - 3. Instrumentation to be used.
  - 4. Sample forms with specific identification for all equipment.



- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
  - 1. Domestic Water System:
    - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
    - b. Water heaters are installed and functioning.
    - c. Piping is complete and all points of outlet are installed.
    - d. Systems are flushed, filled, and air purged.
    - e. Strainers are clean.
    - f. Control valves are functioning in accordance with the sequence of operation.
    - g. Shutoff and balance valves are 100 percent open.
    - h. water circulating pumps are operational and proper rotation is verified.
    - i. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
    - j. Variable-frequency controllers' startup is complete and safeties are verified.
    - k. Suitable access to balancing devices and equipment is provided.
  - 2. Sanitary Sewage/Drainage System:
    - a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
    - b. Piping is complete.
    - c. Sanitary sewage pumps/drainage pumps are operational.
    - d. Control valves are functioning in accordance with the sequence of operation.
    - e. Shutoff valves are 100 percent open.
    - f. Suitable access to equipment is provided.

### 3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.



### 3.4 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
  - 1. Domestic water heaters.
  - 2. Domestic water systems.

### 3.5 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
  - 1. Check expansion tank for proper setting.
  - 2. Check water heater for proper discharge temperature setting.
  - 3. Check flow-control valves for proper position.
  - 4. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

### 3.6 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
  - 1. Measure and record entering- and leaving-water temperatures.
  - 2. Measure and record water flow.
  - 3. Measure and record pressure drop.
  - 4. Record relief valve(s) pressure setting.
  - 5. Capacity: Calculate in Btu/h of heating output.
  - 6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

### 3.7 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
  - 1. Domestic Water Flow Rate: Plus or minus 5 percent. If design value is less than 10 gpm, within 10 percent.

### 3.8 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for



system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.

- B. Status Reports: Prepare weekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

### 3.9 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  - 2. Include a list of instruments used for procedures, along with proof of calibration.
  - 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  - 1. Pump curves.
  - 2. Manufacturers' test data.
  - 3. Field test reports prepared by system and equipment installers.
  - 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  - 1. Title page.
  - 2. Name and address of the TAB specialist.
  - 3. Project name.
  - 4. Project location.
  - 5. Architect's name and address.
  - 6. Engineer's name and address.
  - 7. Contractor's name and address.
  - 8. Report date.
  - 9. Signature of TAB supervisor who certifies the report.
  - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  - 11. Summary of contents, including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  - 12. Nomenclature sheets for each item of equipment.
  - 13. Notes to explain why certain final data in the body of reports vary from indicated values.
  - 14. Test conditions for pump performance forms, including the following:
    - a. Variable-frequency controller settings for variable-flow hydronic systems.
    - b. Settings for pressure controller(s).



- c. Other system operating conditions that affect performance.
  - D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
    - 1. Flow rates.
    - 2. Pipe and valve sizes and locations.
    - 3. Balancing stations.
    - 4. Position of balancing devices.
  - E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
    - 1. Unit Data:
      - a. System identification.
      - b. Location.
      - c. Model number and unit size.
      - d. Manufacturer's serial number.
      - e. Output capacity in Btu/h.
      - f. Number of stages.
      - g. Connected volts, phase, and hertz.
      - h. Rated amperage.
    - 2. Test Data (Indicated and Actual Values):
      - a. Heat output in Btu/h.
      - b. Entering-water temperature in deg F.
      - c. Leaving-water temperature in deg F.
      - d. High-temperature-limit setting in deg F.
      - e. Operating set point in deg F.
      - f. Voltage at each connection.
      - g. Amperage for each phase.
  - F. Instrument Calibration Reports:
    - 1. Report Data:
      - a. Instrument type and make.
      - b. Serial number.
      - c. Application.
      - d. Dates of use.
      - e. Dates of calibration.
- 3.10 VERIFICATION OF TAB REPORT
- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Construction Manager.
  - B. Construction Manager shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.



- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
  - D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
  - E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
    - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
    - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
  - F. Prepare test and inspection reports.
- 3.11 ADDITIONAL TESTS
- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION





## SECTION 22 07 19

### PLUMBING PIPING INSULATION

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Condensate drain piping.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Sustainable Design Submittals:
  - 1. Product Data: For recycled content, indicating postconsumer and preconsumer recycled content and cost.
  - 2. Product Data: For adhesives, mastics, and sealants, indicating VOC content.
  - 3. Laboratory Test Reports: For adhesives, mastics, and sealants, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail attachment and covering of heat tracing inside insulation.
  - 3. Detail insulation application at pipe expansion joints for each type of insulation.
  - 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.
- D. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
  - 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
  - 3. Sheet Jacket Materials: 12 inches square.
  - 4. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of



insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

- C. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size, as well as ASTM standard designation and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### 1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
  - 1. All Insulation Installed Indoors; Outdoors-Installed Insulation in Contact with Airstream: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.



## 2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. K-Flex USA.
- G. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning.
  - 2. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ.
  - 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
  - 4. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

## 2.3 INSULATING CEMENTS

- A. Glass-Fiber Insulating Cement: Comply with ASTM C195.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.



1. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - a. Ramco Insulation, Inc.
- C. Glass-Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.
  1. Manufacturers: Subject to compliance with requirements, provide products by the following:
    - a. Ramco Insulation, Inc.

## 2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Solvent-based adhesive.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA.
    - b. Armacell LLC.
    - c. Foster Brand; H. B. Fuller Construction Products.
    - d. K-Flex USA.
  2. Adhesive: As recommended by flexible elastomeric and polyolefin manufacturer and with a VOC content of 80 g/L or less.
  3. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
  4. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
  5. Wet Flash Point: Below 0 deg F.
  6. Service Temperature Range: 40 to 200 deg F.
  7. Color: Black.
- C. Glass-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Adhesive: As recommended by mineral fiber manufacturer and with a VOC content of 80 g/L or less.
  3. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Verify adhesives have a VOC content of 80 g/L or less.
  3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. P.I.C. Plastics, Inc.
    - c. Proto Corporation.
    - d. Speedline Corporation.
    - e. The Dow Chemical Company.
  2. Adhesive: As recommended by Adhesive - PVC Jacket manufacturer and with a VOC content of 50 g/L or less.
  3. Verify adhesives and sealants comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
1. Mastics: As recommended by insulation manufacturer and with a VOC content of 50 g/L or less.
  2. Verify mastics comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Knauf Insulation.
    - d. Mon-Eco Industries, Inc.
    - e. Vimasco Corporation.
  2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.



5. Color: White.

C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Mon-Eco Industries, Inc.
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: 0 to 180 deg F.
4. Color: White.

D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
2. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
3. Service Temperature Range: Minus 50 to plus 220 deg F.
4. Color: White.

E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Knauf Insulation.
  - d. Mon-Eco Industries, Inc.
  - e. Vimasco Corporation.
2. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Color: White.

## 2.6 LAGGING ADHESIVES

A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Childers Brand; H. B. Fuller Construction Products.
  - b. Foster Brand; H. B. Fuller Construction Products.
  - c. Vimasco Corporation.
2. Verify adhesive is as recommended by insulation manufacturer and has a VOC content of 50 g/L or less.



3. Verify adhesive complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
4. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
5. Service Temperature Range: 0 to plus 180 deg F.
6. Color: White.

## 2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
    - d. Owens Corning.
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 58 to plus 176 deg F.
  4. Color: White or gray.
  5. Verify sealant has a VOC content of 420 g/L or less.
  6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- C. FSK and Metal Jacket Flashing Sealants:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.
    - b. Foster Brand; H. B. Fuller Construction Products.
    - c. Mon-Eco Industries, Inc.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
  5. Verify sealant has a VOC content of 420 g/L or less.
  6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Brand; H. B. Fuller Construction Products.



- b. Foster Brand; H. B. Fuller Construction Products.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.
5. Verify sealant has a VOC content of 420 g/L or less.
6. Verify sealant complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

## 2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
  1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
  2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
  3. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

## 2.9 FIELD-APPLIED JACKETS

- A. Field-applied jackets comply with ASTM C1136, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Airex Manufacturing Inc.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. P.I.C. Plastics, Inc.
    - d. Proto Corporation.
    - e. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.





- b. RPR Products, Inc.
- 2. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
- 3. Stainless Steel Jacket: ASTM A240/A240M.
  - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
  - b. Material, finish, and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
  - e. Factory-Fabricated Fitting Covers:
    - 1) Same material, finish, and thickness as jacket.
    - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
    - 3) Tee covers.
    - 4) Flange and union covers.
    - 5) End caps.
    - 6) Beveled collars.
    - 7) Valve covers.
    - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:



- a. Childers Brand; H. B. Fuller Construction Products.
  - B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in., in a Leno weave, for pipe.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Foster Brand; H. B. Fuller Construction Products.
      - b. Vimasco Corporation.
- 2.11 FIELD-APPLIED CLOTHS
- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..
    - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      - a. Alpha Associates, Inc.
- 2.12 TAPES
- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. 3M Industrial Adhesives and Tapes Division.
      - b. Avery Dennison Corporation, Specialty Tapes Division.
      - c. Ideal Tape Co., Inc., an American Biltrite Company.
      - d. Knauf Insulation.
    - 2. Width: 3 inches.
    - 3. Thickness: 11.5 mils.
    - 4. Adhesion: 90 ounces force/inch in width.
    - 5. Elongation: 2 percent.
    - 6. Tensile Strength: 40 lbf/inch in width.
    - 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
  - B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. 3M Industrial Adhesives and Tapes Division.
      - b. Avery Dennison Corporation, Specialty Tapes Division.
      - c. Ideal Tape Co., Inc., an American Biltrite Company.
      - d. Knauf Insulation.
    - 2. Width: 3 inches.
    - 3. Thickness: 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Ideal Tape Co., Inc., an American Biltrite Company.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. 3M Industrial Adhesives and Tapes Division.
    - b. Avery Dennison Corporation, Specialty Tapes Division.
    - c. Ideal Tape Co., Inc., an American Biltrite Company.
    - d. Knauf Insulation.
  - 2. Width: 2 inches.
  - 3. Thickness: 3.7 mils.
  - 4. Adhesion: 100 ounces force/inch in width.
  - 5. Elongation: 5 percent.
  - 6. Tensile Strength: 34 lbf/inch in width.

## 2.13 SECUREMENTS

- A. Bands:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville; a Berkshire Hathaway company.
    - b. RPR Products, Inc.
  - 2. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
  - 3. Aluminum: ASTM B209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.
- B. Staples: Outward-clinching insulation staples nominal 3/4-inch-wide, stainless steel or Monel.
- C. Wire: 0.080-inch nickel-copper alloy, 0.062-inch soft-annealed, stainless steel or 0.062-inch soft-annealed, galvanized steel.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. C & F Wire Products.
    - b. Johns Manville; a Berkshire Hathaway company.
    - c. RPR Products, Inc.



## 2.14 PROTECTIVE SHIELDING GUARDS

### A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Just Manufacturing.
  - b. McGuire Manufacturing.
  - c. Plumberex Specialty Products, Inc.
  - d. Truebro; IPS Corporation.
  - e. Zurn Industries, LLC.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

### B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Truebro; IPS Corporation.
  - b. Zurn Industries, LLC.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
  1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
  2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.



- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
  - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.



- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.



- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 07 84 13 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and



- including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.





5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of 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 sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
  2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.7 INSTALLATION OF GLASS-FIBER INSULATION

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of preformed pipe insulation to pipe with wire or bands, and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
  4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.



- B. Insulation Installation on Pipe Flanges:
  - 1. Install prefabricated pipe insulation to outer diameter of pipe flange.
  - 2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  - 3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
  - 4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  - 1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
  - 2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  - 1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
  - 2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
  - 3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  - 4. Install insulation to flanges as specified for flange insulation application.

### 3.8 INSTALLATION OF FIELD-APPLIED JACKETS

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  - 1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  - 2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  - 3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  - 1. Draw jacket material smooth and tight.
  - 2. Install lap or joint strips with same material as jacket.
  - 3. Secure jacket to insulation with manufacturer's recommended adhesive.
  - 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  - 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
  - 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.



- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

### 3.9 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."
  - 1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.



### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water & Trap Primer:
  - 1. NPS 3/4 and Smaller: Insulation is one of the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
  - 2. NPS 1 and Larger: Insulation is one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
- B. Domestic Hot Water:
  - 1. NPS 1 and Smaller: Insulation is one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/4 and NPS 1-1/2: Insulation is one of the following:
    - a. Flexible Elastomeric: 1-1/2 inches thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
  - 3. NPS 2 and larger: Insulation is one of the following:
    - a. Flexible Elastomeric: 2" thick.
    - b. Glass-Fiber, Preformed pipe insulation, Type I: 2 inches thick.
- C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  - 1. All Pipe Sizes: Insulation is one of the following:
    - a. Flexible Elastomeric: 1/2 inch thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
- D. Condensate Drains:
  - 1. All Pipe Sizes: Insulation is one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

### 3.13 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping:
  - 1. PVC: 20 mils thick.
  - 2. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION



## SECTION 22 11 16

### DOMESTIC WATER PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Copper tube and fittings.
  - 2. Ductile-iron pipe and fittings.
  - 3. Piping joining materials.
  - 4. Encasement for piping.
  - 5. Transition fittings.
  - 6. Dielectric fittings.
- B. Related Requirements:
  - 1. Section 33 14 15 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

##### 1.2 ACTION SUBMITTALS

- A. Product Data:
  - 1. Pipe and tube.
  - 2. Fittings.
  - 3. Joining materials.
  - 4. Transition fittings.
- B. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
  - 3. Environmental Product Declaration: For each product.
  - 4. Health Product Declaration: For each product.
  - 5. Sourcing of Raw Materials: Corporate sustainability report for each manufacturer.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. System purging and disinfecting activities report.
- B. Field quality-control reports.

##### 1.4 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:



1. Notify Owner no fewer than seven days in advance of proposed interruption of water service.
2. Do not interrupt water service without Owner's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Potable-water piping and components shall comply with NSF 14, NSF 61, and NSF 372.

### 2.2 COPPER TUBE AND FITTINGS

- A. Drawn-Temper Copper Tube: ASTM B88, Type L.
- B. Annealed-Temper Copper Tube: ASTM B88, Type K.
- C. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- E. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- F. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- G. Wrought Copper Unions: ASME B16.22.
- H. Grooved, Mechanical-Joint, Copper Tube Appurtenances:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
    - b. Shurjoint; a part of Aalberts Integrated piping Systems.
    - c. Victaulic Company.
  2. Grooved-End, Copper Fittings: ASTM B75 copper tube or ASTM B584 bronze castings.
  3. Grooved-End-Tube Couplings: To fit copper-tube dimensions; rigid pattern unless otherwise indicated; gasketed fitting, EPDM-rubber gasket, UL classified per NSF 61 and NSF 372, and rated for minimum 180 deg F, for use with ferrous housing and steel bolts and nuts; 300 psig minimum CWP pressure rating.
- I. Copper Tube, Pressure-Seal-Joint Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. Mueller Streamline Co.; a company of Mueller Industries.
    - c. NIBCO INC.
    - d. Viega LLC.
  2. Fittings: Cast-brass, cast-bronze, or wrought-copper with EPDM O-ring seal in each end.



3. Minimum 200-psig working-pressure rating at 250 deg F.

J. Copper-Tube, Push-on-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. NIBCO INC.
  - c. Victaulic Company.
2. Description:
  - a. Cast-copper fitting complying with ASME B16.18 or wrought-copper fitting complying with ASME B 16.22.
  - b. Stainless steel teeth and EPDM-rubber, O-ring seal in each end instead of solder-joint ends.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B32, lead-free alloys.

D. Flux: ASTM B813, water flushable.

E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Form: Sheet or tube.

C. Color: Black or natural.

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Dresser, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Smith-Blair, a Xylem brand.
- D. Plastic-to-Metal Transition Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Charlotte Pipe and Foundry Company.
    - b. Harvel Plastics, Inc.
    - c. Spears Manufacturing Company.
    - d. Uponor.
    - e. aquatherm.
  2. Description:
    - a. CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
    - b. One end with threaded brass insert and one solvent-cement-socket end.
- E. Plastic-to-Metal Transition Unions:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. NIBCO INC.
    - b. Spears Manufacturing Company.
    - c. aquatherm.
  2. Description:
    - a. CPVC four-part union.
    - b. Brass or stainless steel threaded end.
    - c. Solvent-cement-joint plastic end.
    - d. Rubber O-ring.
    - e. Union nut.

## 2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Flanges:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. GF Piping Systems: Georg Fischer LLC.
    - b. Watts Water Technologies; a Watts company.
    - c. Wilkins.
  2. Standard: ASSE 1079.
  3. Factory-fabricated, bolted, companion-flange assembly.
  4. Pressure Rating: 125 psig minimum at 180 deg F.





5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- C. Dielectric-Flange Insulating Kits:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, LLC.
    - b. CALPICO, Inc.
    - c. GF Piping Systems: Georg Fischer LLC.
    - d. GPT; a division of EnPRO Industries.
  2. Nonconducting materials for field assembly of companion flanges.
  3. Pressure Rating: 150 psig.
  4. Gasket: Neoprene or phenolic.
  5. Bolt Sleeves: Phenolic or polyethylene.
  6. Washers: Phenolic with steel backing washers.
- D. Dielectric Nipples:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
    - b. Elster Perfection; Honeywell.
    - c. Matco-Norca.
    - d. Precision Plumbing Products.
    - e. Sioux Chief Manufacturing Company, Inc.
    - f. Victaulic Company.
  2. Standard: IAPMO PS 66.
  3. Electroplated steel nipple complying with ASTM F1545.
  4. Pressure Rating and Temperature: 300 psig at 225 deg F.
  5. End Connections: Male threaded or grooved.
  6. Lining: Inert and noncorrosive, propylene.

## PART 3 - EXECUTION

### 3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  1. Annealed-temper copper tube, ASTM B88, Type K; no fittings or joints allowed.



- E. Under-building-slab, domestic water piping, NPS 2 and smaller, shall be one of the following:
  - 1. Annealed-temper copper tube, ASTM B88, Type K; no fittings or joints allowed.
    - a. Piping to be run within schedule 40 PVC piping. PVC piping to be sized and arranged to allow for the removal and replacement of the copper supply line(s).
- F. Aboveground domestic water piping, NPS 3 and smaller, shall be one of the following:
  - 1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

### 3.2 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube and ductile-iron pipe in PE encasement according to ASTM A674 or AWWA C105/A21.5.
- E. Install valves according to the following:
  - 1. Section 22 05 23.12 "General Duty Valves for Plumbing Piping".
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 22 11 19 "Domestic Water Piping Specialties."
- G. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.
- H. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- I. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- J. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.



- K. Install piping to permit valve servicing.
- L. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- M. Install piping free of sags and bends.
- N. Install fittings for changes in direction and branch connections.
- O. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- P. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements for thermometers in Section 22 05 19 "Meters and Gages for Plumbing Piping."
- Q. Install shut-off valves on inlet and outlet piping from each water heater.
- R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- T. Install escutcheons for piping penetrations of walls, ceilings, and floors in finished areas. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."

### 3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Brazed Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."



- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.
- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- K. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

### 3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
  - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings.

### 3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.
- C. Dielectric Fittings for NPS 2-1/2 and Larger: Use dielectric flange kits.

### 3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for hangers, supports, and anchor devices in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Install hangers for copper, ductile iron and stainless steel tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58,



locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

- C. Support horizontal piping within 12 inches of each fitting.
- D. Support vertical runs of copper and piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  - 2. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
  - 3. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.10 ADJUSTING

- A. Perform the following adjustments before operation:
  - 1. Close drain valves, hydrants, and hose bibbs.
  - 2. Open shutoff valves to fully open position.
  - 3. Open throttling valves to proper setting.
  - 4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
  - 5. Remove and clean strainer screens. Close drain valves and replace drain plugs.
  - 6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
  - 7. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Piping Inspections:



- a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
    - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
  - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
2. Piping Tests:
- a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
  - b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
  - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
  - e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
  - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
  - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.
- 3.12 CLEANING
- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:



- a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
  - b. Fill and isolate system according to either of the following:
    - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
    - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
  - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
  - d. Repeat procedures if biological examination shows contamination.
  - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION



## SECTION 22 11 19

### DOMESTIC WATER PIPING SPECIALTIES

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Automatic water shutoff valve systems.
5. Balancing valves.
6. Temperature-actuated, water mixing valves.
7. Strainers for domestic water piping.
8. Outlet boxes.
9. Hose bibbs.
10. Wall hydrants.
11. Drain valves.
12. Water-hammer arresters.
13. Trap-seal primer device.
14. Trap-seal primer systems.
15. Flexible connectors.
16. Water meters.

###### B. Related Requirements:

1. Section 22 05 19 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Section 22 11 16 "Domestic Water Piping" for water meters.
3. Section 22 05 23 "General Duty Valves for Plumbing Piping" for fire water-service backflow prevention devices.

##### 1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
  1. Include diagrams for power, signal, and control wiring.

##### 1.4 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.





## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

### 2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

### 2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. FEBCO; A WATTS Brand.
    - c. Watts Water Technologies; a Watts company.
  - 2. Standard: ASSE 1001.
  - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 4. Body: Bronze.
  - 5. Inlet and Outlet Connections: Threaded.
  - 6. Finish: Chrome plated.
- B. Hose-Connection Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
    - b. MIFAB, Inc.
    - c. Watts Water Technologies; a Watts company.
    - d. Woodford Manufacturing Company.
  - 2. Standard: ASSE 1011.
  - 3. Body: Bronze, nonremovable, with manual drain.
  - 4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 5. Finish: Chrome plated.
- C. Pressure Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.



- b. FEBCO; A WATTS Brand.
  - c. Watts Water Technologies; a Watts company.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig maximum, through middle third of flow range.
- 5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

## 2.4 BACKFLOW PREVENTERS

### A. Intermediate Atmospheric-Vent Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Cash Acme Plumbing Products; an RWC brand.
  - c. Legend Valve & Fitting, Inc.
  - d. Watts Water Technologies; a Watts company.
- 2. Standard: ASSE 1012.
- 3. Operation: Continuous-pressure applications.
- 4. Body: Bronze.
- 5. End Connections: Union, solder joint.
- 6. Finish: Rough bronze.

### B. Reduced-Pressure-Principle Backflow Preventers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Fire & Waterworks; A WATTS Brand.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Caleffi North America.
  - d. FEBCO; A WATTS Brand.
  - e. Watts Water Technologies; a Watts company.
- 2. Standard: ASSE 1013.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 12 psig maximum, through middle third of flow range.
- 5. Body: Bronze for NPS 2 and smaller; ductile or cast iron with interior lining that complies with AWWA C550 or that is FDA approved or stainless steel for NPS 2-1/2 and larger.
- 6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
- 7. Configuration: Designed for horizontal, straight-through flow.
- 8. Accessories:
  - a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
  - b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
  - c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

### C. Dual-Check-Valve Backflow Preventers:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Caleffi North America.
  - c. Cash Acme Plumbing Products; an RWC brand.
  - d. Flomatic Valves; Flomatic Corporation.
  - e. Watts Water Technologies; a Watts company.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.

## 2.5 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. Caleffi North America.
  - c. Cash Acme Plumbing Products; an RWC brand.
  - d. Watts Water Technologies; a Watts company.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Body: Bronze with chrome-plated finish for NPS 2 and smaller; bronze or cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
5. Valves for Booster Heater Water Supply: Include integral bypass.
6. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

### B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - b. CLA-VAL.
  - c. Flomatic Valves; Flomatic Corporation.
  - d. Watts Water Technologies; a Watts company.
2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless steel body.
5. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

## 2.6 BALANCING VALVES

### A. Automatic Flow Control Balancing Valves:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Caleffi North America.
  - b. IMI Hydronic Engineering Inc.
  - c. ThermOmegaTech.
2. Flow Regulation: Plus or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless steel or antiscale polymer.
7. End Connections: Threaded or solder joint.

## 2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

### A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Leonard Valve Company.
  - d. POWERS; A WATTS Brand.
  - e. Symmons Industries, Inc.
  - f. Taco Comfort Solutions.
  - g. Watts Water Technologies; a Watts company.
2. Standard: ASSE 1070.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

### B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Apollo Valves; a part of Aalberts Integrated Piping Systems.
  - c. Caleffi North America.
  - d. Lawler Manufacturing Company, Inc.
  - e. Leonard Valve Company.
  - f. POWERS; A WATTS Brand.
  - g. Symmons Industries, Inc.
  - h. Watts Water Technologies; a Watts company.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Type: Exposed-mounted, thermostatically controlled, water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.



7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.

C. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company; a Division of Morris Group International.
  - b. Lawler Manufacturing Company, Inc.
  - c. Leonard Valve Company.
  - d. POWERS; A WATTS Brand.
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.

## 2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Keckley Company.
  - b. Watts Water Technologies; a Watts company.
2. Pressure Rating: 125 psig minimum unless otherwise indicated.
3. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
4. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
5. Screen: Stainless steel with round perforations unless otherwise indicated.
6. Drain: Factory-installed, hose-end drain valve.

## 2.9 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. MIFAB, Inc.
  - c. Prier Products, Inc.
  - d. Watts Water Technologies; a Watts company.
  - e. Woodford Manufacturing Company.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.



8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Rough bronze.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.10 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Jay R. Smith Mfg Co; a division of Morris Group International.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. Watts Water Technologies; a Watts company.
  - e. Woodford Manufacturing Company.
  - f. Zurn Industries, LLC.
2. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet, Concealed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounted with cover.
9. Box and Cover Finish: Polished nickel bronze.
10. Outlet, Exposed: With integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
11. Nozzle and Wall-Plate Finish: Polished nickel bronze.
12. Operating Keys(s): One with each wall hydrant.

## 2.11 DRAIN VALVES

### A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.



9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

## 2.12 WATER-HAMMER ARRESTERS

### A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Jay R. Smith Mfg Co; a division of Morris Group International.
  - c. Josam Company.
  - d. MIFAB, Inc.
  - e. Precision Plumbing Products.
  - f. Sioux Chief Manufacturing Company, Inc.
  - g. Watts Water Technologies; a Watts company.
  - h. Zurn Industries, LLC.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Diaphragm.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

## 2.13 TRAP-SEAL PRIMER SYSTEMS

### A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Precision Plumbing Products.
  - b. Sioux Chief Manufacturing Company, Inc.
  - c. Zurn Industries, LLC.
2. Standard: ASSE 1044.
3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
4. Vacuum Breaker: ASSE 1001.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
  1. Locate backflow preventers in same room as connected equipment or system.
  2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
  3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.



- C. Water Control Valves: Install with inlet and outlet shutoff valves. Install pressure gauges on inlet and outlet.
- D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve and pump.
- G. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- H. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.
- I. Vacuum Breakers: Install on the cold water inlet side of the domestic water heater after the shut-off valve.

### 3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

### 3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 26 05 26 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

### 3.4 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Water pressure-reducing valves.
  - 4. Automatic water shutoff valve systems.
  - 5. Balancing valves.
  - 6. Temperature-actuated, water mixing valves.
  - 7. Outlet boxes.
  - 8. Hose stations.





9. Wall hydrants.
10. Ground hydrants.
11. Post hydrants.
12. Roof hydrants.
13. Trap-seal primer device.
14. Trap-seal primer systems.
15. Water meters.

- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.5 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each reduced-pressure-principle backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

### 3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections.
  1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.
  2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
  4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION



## SECTION 22 13 16

### SANITARY WASTE AND VENT PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section Includes:
  - 1. Hub-and-spigot, cast-iron soil pipe and fittings.
  - 2. Hubless, cast-iron soil pipe and fittings.
  - 3. Copper tube and fittings.
  - 4. PVC pipe and fittings.
  - 5. Specialty pipe fittings.
  - 6. Encasement for underground metal piping.

##### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
  - 1. Product Data: For adhesives, indicating VOC content.
  - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

##### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans and elevations, or Building Information Model (BIM) drawn to scale, showing items described in this Section and coordinated with all building trades.
- B. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

##### 1.4 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
  - 1. Notify Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.



2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

## 1.5 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
  1. Soil, Waste, and Vent Piping: 10 ft. head of water.
  2. Waste, Force-Main Piping: 150 psig.

### 2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark.
  2. ASTM A74, service and extra-heavy cast iron.
- C. Gaskets: ASTM C564, rubber.
- D. Caulking Materials: ASTM B29, pure lead and oakum or hemp fiber.

### 2.4 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. AB & I Foundry; a part of the McWane family of companies.
  2. Charlotte Pipe and Foundry Company.
  3. Tyler Pipe; a part of McWane family of companies.
- B. Pipe and Fittings:
  1. Marked with CISPI collective trademark.
  2. ASTM A888 or CISPI 301.



- C. Heavy-Duty, Hubless-Piping Couplings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. AB & I Foundry; a part of the McWane family of companies.
    - b. ANACO-Husky.
    - c. Charlotte Pipe and Foundry Company.
    - d. MIFAB, Inc.
    - e. Mission Rubber Company, LLC; a division of MCP Industries.
    - f. Tyler Pipe; a subsidiary of McWane Inc.
  2. Standards: ASTM C1277 and ASTM C1540.
  3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, rubber sleeve with integral, center pipe stop.

## 2.5 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cambridge-Lee Industries, LLC.
  2. Cerro Flow Products, LLC.
  3. Mueller Streamline Co.; a company of Mueller Industries.
  4. Wieland Copper Products, LLC.
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
- F. Copper Pressure Fittings:
1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
  2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- G. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
  2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- H. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

## 2.6 PVC PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Charlotte Pipe and Foundry Company.
  2. GF Piping Systems.
  3. JM Eagle.



4. Mueller Streamline Co.; a company of Mueller Industries.
  5. National Pipe and Plastic, Inc.
  6. North America Pipe Corporation.
  7. Rocky Mountain Colby Pipe Company.
  8. Silver-line Plastics.
- B. Comply with NSF 14 for plastic piping components. Include "NSF-dwv" marking for plastic drain, waste, and vent piping and "NSF-sewer" marking for plastic sewer piping.
- C. Solid-Wall PVC Pipe: ASTM D2665 drain, waste, and vent.
- D. PVC Socket Fittings: ASTM D2665, made in accordance with ASTM D3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- E. Adhesive Primer: ASTM F656.
1. Verify adhesive primer complies with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
- F. Solvent Cement: ASTM D2564.
1. Verify solvent cement has a VOC content of 510 g/L or less.
- 2.7 SPECIALTY PIPE FITTINGS
- A. Transition Couplings:
1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
  2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  3. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Mission Rubber Company, LLC; a division of MCP Industries.
      - 4) Plastic Oddities.
    - b. Standard: ASTM C1173.
    - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.
    - e. Sleeve Materials:
      - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
      - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
      - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
  4. Shielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- 1) Cascade Waterworks Mfg. Co.
      - 2) Mission Rubber Company, LLC; a division of MCP Industries.
    - b. Standard: ASTM C1460.
    - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - d. End Connections: Same size as and compatible with pipes to be joined.
  5. Pressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Apollo Valves; a part of Aalberts Integrated Piping Systems.
      - 2) Cascade Waterworks Mfg. Co.
      - 3) EBAA Iron Sales, Inc.
      - 4) Ford Meter Box Company, Inc. (The).
      - 5) JCM Industries, Inc.
      - 6) Romac Industries, Inc.
    - b. Standard: AWWA C219.
    - c. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
    - d. Gasket Material: Natural or synthetic rubber.
    - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
  2. Dielectric Flanges:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Capitol Manufacturing Company.
      - 2) GF Piping Systems: Georg Fischer LLC.
      - 3) Matco-Norca.
      - 4) Watts Water Technologies; a Watts company.
      - 5) Zurn Industries, LLC.
    - b. Description:
      - 1) Standard: ASSE 1079.
      - 2) Factory-fabricated, bolted, companion-flange assembly.
      - 3) Pressure Rating: 125 psig minimum at 180 deg F.
      - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
  3. Dielectric-Flange Insulating Kits:
    - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Advance Products & Systems, LLC.
      - 2) CALPICO, Inc.
      - 3) GF Piping Systems: Georg Fischer LLC.
      - 4) GPT; a division of EnPRO Industries.
    - b. Description:
      - 1) Nonconducting materials for field assembly of companion flanges.



- 2) Pressure Rating: 150 psig.
  - 3) Gasket: Neoprene or phenolic.
  - 4) Bolt Sleeves: Phenolic or polyethylene.
  - 5) Washers: Phenolic with steel backing washers.
4. Dielectric Nipples:
- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Anvil International/Smith-Cooper International; Tailwind Capital, LLC.
    - 2) Elster Perfection; Honeywell.
    - 3) Matco-Norca.
    - 4) Precision Plumbing Products.
    - 5) Victaulic Company.
  - b. Description:
    - 1) Standard: IAPMO PS 66.
    - 2) Electroplated steel nipple.
    - 3) Pressure Rating: 300 psig at 225 deg F.
    - 4) End Connections: Male threaded or grooved.
    - 5) Lining: Inert and noncorrosive, propylene.

## 2.8 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A674 or AWWA C105/A 21.5.
- B. Material: high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31.

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
  1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
  2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.



- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
  - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
  - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe.
    - a. Straight tees, elbows, and crosses may be used on vent lines.
  - 3. Do not change direction of flow more than 90 degrees.
  - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
    - a. Reducing size of waste piping in direction of flow is prohibited.
- K. Lay buried building waste piping beginning at low point of each system.
  - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
  - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
  - 3. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; two percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
  - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- N. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- O. Install underground PVC piping in accordance with ASTM D2321.
- P. Install engineered soil and waste and vent piping systems as follows:





1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
  2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
  3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Install underground, copper, force-main tubing in accordance with CDA's "Copper Tube Handbook."
1. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- R. Install force mains at elevations indicated.
- S. Plumbing Specialties:
1. Install backwater valves in sanitary waster gravity-flow piping.
    - a. Comply with requirements for backwater valves specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
    - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
    - b. Comply with requirements for cleanouts specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  3. Install drains in sanitary waste gravity-flow piping.
    - a. Comply with requirements for drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- U. Install sleeves for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for sleeves specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs.
1. Comply with requirements for sleeve seals specified in Section 22 05 17 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors.
1. Comply with requirements for escutcheons specified in Section 22 05 18 "Escutcheons for Plumbing Piping."
- ### 3.3 JOINT CONSTRUCTION
- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:



1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
  1. Cut threads full and clean using sharp dies.
  2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
    - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
    - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
    - c. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- H. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings in accordance with the following:
  1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. ABS Piping: Join in accordance with ASTM D2235 and ASTM D2661 appendixes.
  3. PVC Piping: Join in accordance with ASTM D2855 and ASTM D2665 appendixes.
- I. Joint Restraints and Sway Bracing:
  1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
    - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
    - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
    - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  1. Install transition couplings at joints of piping with small differences in ODs.
  2. In Waste Drainage Piping: nonpressure transition couplings.
  3. In Aboveground Force Main Piping: Fitting-type transition couplings.



4. In Underground Force Main Piping:
  - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
  - b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples.
3. Dielectric Fittings for NPS 2-1/2 and larger: Use dielectric flange kits.

### 3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:

1. Section 22 05 23 "General Duty Valves for Plumbing Piping".

B. Shutoff Valves:

1. Install shutoff valve on each sewage pump discharge.
2. Install **gate** for piping NPS 2 and smaller.
3. Install **gate** for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

D. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. **Use normally closed type unless otherwise indicated.**
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 22 13 19 "Sanitary Waste Piping Specialties."

### 3.6 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 22 05 29 "Hangers and Supports for Plumbing Piping and Equipment".

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42 clamps.
6. Install individual, straight, horizontal piping runs:
  - a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
  - c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.



7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
  8. Base of Vertical Piping: MSS Type 52 spring hangers.
- B. Install hangers for cast-iron, stainless steel and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- C. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.
- D. Support vertical runs of cast-iron, stainless steel and copper soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Install horizontal backwater valves with cleanout cover flush with floor. Comply with requirements for backwater valves, cleanouts and drains specified in Section 22 13 19 "Sanitary Waste Piping Specialties."
  6. Equipment: Connect waste piping as indicated.
    - a. Provide shutoff valve if indicated and union for each connection.
    - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.
- D. Connect force-main piping to the following:
1. Sanitary Sewer: To exterior force main.
  2. Sewage Pump: To sewage pump discharge.
- E. Where installing piping adjacent to equipment allow space for service and maintenance of equipment.
- F. Make connections in accordance with the following unless otherwise indicated:
1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.



### 3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 22 05 53 "Identification for Plumbing Piping and Equipment."

### 3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
    - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
    - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
    - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
    - c. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
    - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
    - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
    - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
    - d. Inspect plumbing fixture connections for gas and water leaks.
  - 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.



6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
    - a. Expose work that was covered or concealed before it was tested.
  2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
    - a. Isolate test source and allow to stand for four hours.
    - b. Leaks and loss in test pressure constitute defects that must be repaired.
  3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  4. Prepare reports for tests and required corrective action.

### 3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during the remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Exposed **PVC** Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.
- E. Repair damage to adjacent materials caused by waste and vent piping installation.

### 3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil, vent and waste piping are to be any of the following:
  1. Cast-Iron DWV Piping to match existing piping and joints.
  2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground Condensate Drains are to be the following:
  1. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  2. Insulate per 22 07 19.

END OF SECTION



## SECTION 22 35 00

### DOMESTIC WATER HEAT EXCHANGERS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section describes the requirements for domestic hot water heat exchangers including thermometers and all necessary accessories, connections and equipment.
- B. Application is for electric heat pump water heaters.
- C. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, Common Work Results for Plumbing.

##### 1.2 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society for Heating, Refrigerating and Air Conditioning Engineers (ASHRAE):
  - 90.1 (2013).....Energy Standard for Buildings Except Low-Rise Residential Buildings
- C. American National Standard Institute (ANSI):
  - Z21.22B-2001 (R2008).....Relief Valves for Hot Water Supply Systems
- D. American Society of Mechanical Engineers (ASME):
  - ASME Boiler and Pressure Vessel Code –
  - BPVC Section IV-2013.....Rules for Construction of Heating Boilers
  - BPVC Section VIII-1-2013.Rules for Construction of Pressure Vessels, Division 1
  - Form U-1.....Manufacturer's Data Report for Pressure Vessels
  - B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
  - B16.5-2013.....Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24  
Metric/Inch Standard
  - B16.24-2011.....Cast Copper Alloy Pipe Flanges and Flanged Fittings:  
Classes 150, 300, 600, 900, 1500, and 2500
  - PTC 25.3-02.....Pressure Relief Devices
- E. National Fire Protection Association (NFPA):
  - 70-2011 .....National Electrical Code (NEC)
- F. NSF International (NSF):
  - 61-2012 .....Drinking Water System Components – Health Effects
  - 372-2011 .....Drinking Water System Components – Lead Content



- G. Underwriter Laboratories (UL):  
207-2013 .....Standard for Refrigerant-Containing Components and  
Accessories, Nonelectrical  
778-2002 .....Standard for Motor-Operated Water Pumps

### 1.3 SUBMITTALS

- A. Manufacturer's Literature and Data including: Full item description and optional features and accessories. Include dimensions, weights, materials, applications, standard compliance, model numbers, size, and capacity.
1. Heat Exchangers.
  2. Pressure and Temperature Relief Valves.
  3. Heating Hot Water Control Valves.
  4. Thermometers.
  5. Pressure Gages.
  6. Vacuum Breakers.
  7. Safety Valves.
  8. Expansion Tanks.
- B. See Section 22 05 11, Common Work Results For Plumbing, Article 1.3 Submittals for further requirements.

### 1.4 QUALITY ASSURANCE

- A. Equipment components in contact with potable water shall meet compliance requirements in documents NSF 61 and NSF 372.
- B. See Section 22 00 00, Basic Plumbing Requirements

## PART 2 - PRODUCTS

### 2.1 DOMESTIC HOT WATER HEATER

- A. Shall be as shown on Drawings.

### 2.2 THERMOMETERS

- A. Thermometers shall be rigid stem or remote sensing, scale or dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, red liquid (alcohol or organic-based) fill, vapor, bi-metal or gas actuated, with 9 inches high scale dial or circular dial 2 to 5 inches in diameter graduated from 40 to 210 degrees F, with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 2 1/2 inches to clear tank or pipe covering. The thermometer shall be suitable for 3/4 inch pipe threads. Thermometers may be console-mounted with sensor installed in separate thermometer well.
- B.





## 2.3 SAFETY VALVES FOR SHELL AND COIL HEATERS

- A. Separate combination pressure/temperature relief valves shall be provided on each water heater.

## 2.4 DOMESTIC HOT WATER EXPANSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as indicated on drawings. The air precharge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The air charging valve shall be factory installed.

## 2.5 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination pressure and temperature relief Valve shall be ANSI Z21.22 and ASME rated and constructed of all brass or bronze with a self-closing reseating valve. The relief valves shall include a relieving capacity greater than the heat input and include a pressure setting less than the water heater's working pressure rating. Sensing element shall extend into storage tank.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. The water heaters shall be on a 4" tall housekeeping pad with drain pan.
- B. The water heaters shall be installed level and plumb and securely anchored.
- C. Water heaters shall be installed and connected in accordance with manufacturer's written instructions with manufacturer's recommended clearances.
- D. All pressure and temperature relief valves discharge shall be piped to 6 inches above finished floor.
- E. Thermometers and isolation valves shall be installed on water heater inlet and outlet piping and shall be positioned such that they can be read by an operator or staff standing on floor or walkway.
- F. The thermostatic control shall be set for a minimum setting of 130 degrees F.
- G. Shutoff valves shall be installed on the domestic water supply piping to the water heater and on the domestic hot water outlet piping.
- H. All manufacturer's required clearances shall be maintained.



- I. A combination temperature and pressure relief valve shall be installed at the top portion of the storage tank. The sensing element shall extend into the tank. The relief valve outlet drain piping shall discharge to the floor.
- J. Dielectric unions shall be provided if there are dissimilar metals between the water heater connections and the attached piping.
- K. Provide vacuum breakers per ANSI Z21.22 on the inlet pipe if the water heater.
- L. Provide unions between the last accessory and the water heater on the inlet and outlet pipes.

### 3.2 PERFORMANCE TEST

- A. Ensure that all of the remote water outlets will have a minimum of 120 degrees F and a maximum of 130 degrees F water flow at all times. If necessary, make all correction to balance the return water system or reset the thermostat to make the system comply with design requirements.

### 3.3 STARTUP AND TESTING

- A. As recommended by product manufacturer and listed standards and under actual or simulated operating conditions, tests shall be conducted to prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with each integrated system.
- B. When any defects are detected, correct defects and repeat test at no additional costs to the Owner.

END OF SECTION



## SECTION 22 40 00

### PLUMBING FIXTURES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

##### 1.2 SUBMITTALS

- A. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.
- B. See Section 23 05 11, Common Work Results for Plumbing, Article 1.3 Submittals for further requirements.
- C. See Section 23 05 11, Common Work Results for Plumbing, Article 1.4 Quality Assurance.

##### 1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):  
The American Society of Mechanical Engineers (ASME):  
A112.6.1M-02(R2008) .....Floor Affixed Supports for Off-the-Floor Plumbing  
Fixtures for Public Use  
A112.19.1M-08 .....Enameled Cast Iron Plumbing Fixtures  
A112.19.2M-03.....Vitreous China Plumbing Fixtures  
A112.19.3-2001(R2008).....Stainless Steel Plumbing Fixtures (Designed for Residential  
Use)
- C. American Society for Testing and Materials (ASTM):  
A276-2010 .....Stainless and Heat-Resisting Steel Bars and Shapes  
WW-P-541-E/GEN .....Plumbing Fixtures with Amendment 1
- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM  
AMP 500-505 Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):  
1016-05 .....Performance Requirements for Individual Thermostatic,  
Pressure Balancing and Combination Pressure Balancing  
and Thermostatic Control Valves for Individual Fixture  
Fittings



- F. NSF International (NSF)
  - NSF/ANSI 14 (2013) .....Plastics Piping System Components and Related Materials
  - NSF/ANSI 61 (2012) .....Drinking Water System Components – Health Effects
  - NSF/ANSI 372 (2011) .....Drinking Water System Components – Lead Content
- G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and Surfaces.
- H. Environmental Protection Agency EPA PL 93-523 1974; A 1999 Safe Drinking Water Act.
- I. International Building Code, ICC IPC 2012.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption and shall be certified in accordance with NSF/ANSI 61 or NSF 372. Endpoint devices used to dispense water for drinking must meet the requirements of NSF/ANSI 61, Section 9.
- B. Plastic pipe, fittings, and solvent cement shall meet NSF/ANSI 14 and shall be NSF listed for the service intended.

### 2.2 STAINLESS STEEL

- A. Corrosion-resistant Steel (CRS):
  - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
  - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

### 2.3 STOPS

- A. Provide lock-shield loose key or screwdriver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework. Locate stops centrally above or below fixture in accessible location.
- B. Furnish keys for lock shield stops to Owner.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.



## 2.4 ESCUTCHEONS

- A. Heavy type, chrome plated, with set screws. Provide piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

## 2.5 LAMINAR FLOW CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
  - 1. Capable of restricting flow from 1.5 gpm to 1.7 gpm for lavatories; 2.0 gpm to 2.2 gpm for sinks; and 2.75 gpm to 3.0 gpm for dietary food preparation and rinse sinks or as specified.
  - 2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 25 psi and 80 psi.
  - 3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

## 2.6 CARRIERS

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, chair carrier for thin wall construction or steel plate type. All lavatory chair carriers shall be capable of supporting the lavatory with a 250-pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

## 2.7 FIXTURES

- A. Shall be as Scheduled on drawings.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed with approved sealant.



- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Toggle Bolts: For hollow masonry units, finished or unfinished.
- D. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 1/4 inch diameter bolts, and to extend at least 3 inches into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- E. Power Set Fasteners: May be used for concrete walls, shall be 1/4 inch threaded studs, and shall extend at least 1 1/4 inches into wall.
- F. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.
- G. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.

### 3.2 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

END OF SECTION



## SECTION 23 05 11

### COMMON WORK RESULTS FOR HVAC

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. The requirements of this Section apply to all sections of Division 23.
- B. Definitions:
  - 1. Exposed: Piping, ductwork, and equipment exposed to view in finished rooms.
  - 2. Option or optional: Contractor's choice of an alternate material or method.

##### 1.2 RELATED WORK

- A. All of Division 23 Sections.
- B. Section 26 05 11 - Requirements for Electrical Installations.

##### 1.3 QUALITY ASSURANCE

- A. Mechanical, electrical and associated systems shall be safe, reliable, efficient, durable, easily and safely operable and maintainable, easily and safely accessible, and in compliance with applicable codes as specified. The systems shall be comprised of high quality commercial-class products of manufacturers that are experienced specialists in the required product lines.
- B. Flow Rate Tolerance for HVAC Equipment: Section 22 05 93, Testing, Adjusting, and Balancing for HVAC.
- C. Products Criteria:
  - 1. Standard Products: Material and equipment shall be new and of standard products of a manufacturer regularly engaged in the manufacture of the products for at least 3 years (or longer as specified elsewhere). The design, model and size of each item shall have been in satisfactory and efficient operation on at least three installations for approximately three years.
  - 2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
  - 3. Conform to codes and standards as required by the specifications. Conform to local codes, if required by local authorities such as the gas supplier, if the local codes are more stringent than those specified. Refer any conflicts to the Engineer.
  - 4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
  - 5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.



6. Nameplates: Nameplate bearing manufacturer's name or identifiable trademark shall be securely affixed in a conspicuous place on equipment, or name or trademark cast integrally with equipment, stamped or otherwise permanently marked on each item of equipment.
7. Asbestos products or equipment or materials containing asbestos shall not be used.

D. Execution (Installation, Construction) Quality:

1. Apply and install all items in accordance with manufacturer's written instructions. Refer conflicts between the manufacturer's instructions and the contract drawings and specifications to the Engineer for resolution. Provide written hard copies or computer files of manufacturer's installation instructions to the Engineer at least two weeks prior to commencing installation of any item. Installation of the item will not be allowed to proceed until the recommendations are received. Failure to furnish these recommendations is a cause for rejection of the material.

#### 1.4 SUBMITTALS

- A. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements.
- B. If equipment is submitted which differs in arrangement from that shown, provide drawings that show the rearrangement of all associated systems. Approval will be given only if all features of the equipment and associated systems, including accessibility, are equivalent to that required by the contract.
- C. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group.
- D. Manufacturer's Literature and Data: Submit under the pertinent section rather than under this section.
  1. Submit belt drive with the driven equipment. Submit selection data for specific drives when requested by the Engineer.
  2. Submit electric motor data and variable speed drive data with the driven equipment.
  3. Equipment and materials identification.
  4. Fire-stopping materials.
  6. Wall, floor, and ceiling plates.
- E. Provide copies of approved HVAC equipment submittals to the Testing, Adjusting and Balancing Subcontractor.
- F. Submit for approval, all of the items specifically mentioned under the separate sections of the specification, with information sufficient to evidence full compliance with contract requirements. Materials, fabricated articles and the like to be installed in permanent work shall equal those of approved submittals. After an item has been approved, no change in brand or make will be permitted unless:
  1. Other conditions become apparent which indicates approval of such substitute item to be in best interest of the Owner.





## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating and Refrigeration Institute (AHRI):  
430-2009 .....Central Station Air-Handling Units
- C. American National Standard Institute (ANSI):  
B31.1-2007.....Power Piping
- D. Rubber Manufacturers Association (ANSI/RMA):  
IP-20-2007 .....Specifications for Drives Using Classical V-Belts and Sheaves  
IP-21-2009 .....Specifications for Drives Using Double-V (Hexagonal) Belts  
IP-22-2007 .....Specifications for Drives Using Narrow V-Belts and Sheaves
- E. Air Movement and Control Association (AMCA):  
410-96 .....Recommended Safety Practices for Air Moving Devices
- F. American Society of Mechanical Engineers (ASME):  
Boiler and Pressure Vessel Code (BPVC):  
Section I-2007 .....Power Boilers  
Section IX-2007 .....Welding and Brazing Qualifications  
Code for Pressure Piping:  
B31.1-2007.....Power Piping
- G. American Society for Testing and Materials (ASTM):  
A36/A36M-08.....Standard Specification for Carbon Structural Steel  
A575-96(2007).....Standard Specification for Steel Bars, Carbon, Merchant  
Quality, M-Grades  
E84-10.....Standard Test Method for Surface Burning Characteristics  
of Building Materials  
E119-09c .....Standard Test Methods for Fire Tests of Building Construction  
and Materials
- H. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:  
SP-58-2009 .....Pipe Hangers and Supports-Materials, Design and  
Manufacture, Selection, Application, and Installation  
SP 69-2003.....Pipe Hangers and Supports-Selection and Application  
SP 127-2001.....Bracing for Piping Systems, Seismic – Wind – Dynamic,  
Design, Selection, Application
- I. National Electrical Manufacturers Association (NEMA):  
MG-1-2009 .....Motors and Generators
- J. National Fire Protection Association (NFPA):  
31-06 .....Standard for Installation of Oil-Burning Equipment  
54-09 .....National Fuel Gas Code



70-08 .....	National Electrical Code
85-07 .....	Boiler and Combustion Systems Hazards Code
90A-09 .....	Standard for the Installation of Air Conditioning and Ventilating Systems
101-09 .....	Life Safety Code

## 1.6 DELIVERY, STORAGE AND HANDLING

### A. Protection of Equipment:

1. Equipment and material placed on the job site shall remain in the custody of the Contractor until phased acceptance, whether or not the Government has reimbursed the Contractor for the equipment and material. The Contractor is solely responsible for the protection of such equipment and material against any damage.
2. Place damaged equipment in first class, new operating condition; or, replace same as determined and directed by the Engineer. Such repair or replacement shall be at no additional cost to the Owner.
3. Protect interiors of new equipment and piping systems against entry of foreign matter. Clean both inside and outside before painting or placing equipment in operation.

### B. Cleanliness of Piping and Equipment Systems:

1. Exercise care in storage and handling of equipment and piping material to be incorporated in the work. Remove debris arising from cutting, threading and welding of piping.
2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
3. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

## 1.7 QUALITY ASSURANCE

### A. Products Criteria:

1. Standard Products: Material and equipment shall be new, and the standard products of a manufacturer regularly engaged in the manufacture, supply and servicing of the specified products for at least 5 years.
2. All items furnished shall be free from defects that would adversely affect the performance, maintainability and appearance of individual components and overall assembly.
3. The products and execution of work specified in Division 23 shall conform to the referenced codes and standards as required by the specifications. Local codes and amendments enforced by the local code official shall be enforced. If the local codes are more stringent, then the local code shall apply.
4. Multiple Units: When two or more units of materials or equipment of the same type or class are required, these units shall be products of one manufacturer.
5. Assembled Units: Manufacturers of equipment assemblies, which use components made by others, assume complete responsibility for the final assembled product.
6. Asbestos products or equipment or materials containing asbestos shall not be used.



- B. Execution (Installation, Construction) Quality:
  - 1. All items that require access, such as for operating, cleaning, servicing, maintenance, and calibration, shall be easily and safely accessible.
  - 2. Installer Qualifications: Installer shall be licensed by the State of Maine.
  - 3. If an installation is unsatisfactory to the Owner/Engineer, the Contractor shall correct the installation at no additional cost or additional time to the Owner.
- C. Cleanliness of Piping and Equipment Systems:
  - 1. Care shall be exercised in the storage and handling of equipment and piping material to be incorporated in the work. Debris arising from cutting, threading and welding of piping shall be removed.
  - 2. Piping systems shall be flushed, blown or pigged as necessary to deliver clean systems.
  - 3. The interior of all tanks shall be cleaned prior to delivery and beneficial use by the Government. All piping shall be tested in accordance with the specifications. All filters, strainers, fixture faucets shall be flushed of debris prior to final acceptance.
  - 4. Contractor shall be fully responsible for all costs, damage, and delay arising from failure to provide clean systems.

#### 1.8 PERMITS, INSPECTIONS, AND CODES

- A. The installation shall be in full compliance with all local codes regarding all HVAC installations in effect at the site location and regulations of any other agency having jurisdiction and with the regulations of the State of Maine.
- B. Conflicts arising between the plans and/or specifications with codes or local ordinances, the HVAC Contractor shall submit these conflicts to the Engineer before starting any work. Any work, done prior to this submittal, that needs to be changed to conform to these codes or ordinances shall be made at the HVAC Contractor's expense.
- C. The HVAC Contractor shall acquire and pay for all permits and inspections as relating to scope of work for completion of all HVAC work as indicated on the drawings and herein with these specifications.
- D. After completion of the work, the Contractor shall furnish to the Engineer for the Owner, a certificate of final inspection and acceptance from the inspector having jurisdiction.

#### 1.9 EXTRA WORK

- A. Extra work shall not be performed unless approved by the Engineer/Owner. If extra work is required the Contractor shall submit an itemized list of the work and shall include any credits or work omitted.

#### 1.10 COORDINATION

- A. The HVAC Contractor shall coordinate their work with the General Contractor as well as all other Contractors in a timely manner so as to not cause unnecessary delays in project progress.



## 1.11 WARRANTY

- A. All work performed, and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Owner.
- B. All mechanical equipment shall be provided with the manufacturer's standard warranty period for equipment and components. Equipment substitutions shall carry the same warranty period as the scheduled equipment.
- C. The contractor shall submit all required documentation to the manufacturer and provide proof to the owner that the equipment is warrantied.

## PART 2 - PRODUCTS

### 2.1 FACTORY-ASSEMBLED PRODUCTS

- A. Provide maximum standardization of components to reduce spare part requirements.
- B. Manufacturers of equipment assemblies that include components made by others shall assume complete responsibility for final assembled unit.
  - 1. All components of an assembled unit need not be products of same manufacturer.
  - 2. Constituent parts that are alike shall be products of a single manufacturer.
  - 3. Components shall be compatible with each other and with the total assembly for intended service.
  - 4. Contractor shall guarantee performance of assemblies of components and shall repair or replace elements of the assemblies as required to deliver specified performance of the complete assembly.
- C. Components of equipment shall bear manufacturer's name and trademark, model number, serial number and performance data on a name plate securely affixed in a conspicuous place, or cast integral with, stamped or otherwise permanently marked upon the components of the equipment.
- D. Major items of equipment, which serve the same function, must be the same make and model. Exceptions will be permitted if performance requirements cannot be met.

### 2.2 COMPATIBILITY OF RELATED EQUIPMENT

- A. Equipment and materials installed shall be compatible in all respects with other items being furnished and with existing items so that the result will be a complete and fully operational system that conforms to contract requirements.

### 2.3 LIFTING ATTACHMENTS

- A. Provide equipment with suitable lifting attachments to enable equipment to be lifted in its normal position. Lifting attachments shall withstand any handling conditions that might be encountered, without bending or distortion of shape, such as rapid lowering and braking of load.



## 2.4 HVAC PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. Supports for Roof Mounted Items:
  - 1. Equipment: Equipment rails shall be galvanized steel, minimum 18 gauge, with integral baseplate, continuous welded corner seams, factory installed 2 by 4 treated wood nailer, 18-gauge galvanized steel counter flashing cap with screws, built-in cant strip, (except for gypsum or tectum deck), minimum height 11 inches. For surface insulated roof deck, provide raised cant strip to start at the upper surface of the insulation.
  - 2. Pipe/duct pedestals: Provide a galvanized Unistrut channel welded to U-shaped mounting brackets which are secured to side of rail with galvanized lag bolts.
- B. Attachment to Wood Construction: Wood screws or lag bolts.
- C. Hanger Rods: Hot-rolled steel, ASTM A36 or A575 for allowable load listed in MSS SP-58. For piping, provide adjustment means for controlling level or slope. Types 13 or 15 turn-buckles shall provide 1-1/2 inches minimum of adjustment and incorporate locknuts. All-thread rods are acceptable.
- D. Hangers Supporting Multiple Pipes (Trapeze Hangers): Galvanized, cold formed, lipped steel channel horizontal member, not less than 1-5/8 inches by 1-5/8 inches, No. 12 gage, designed to accept special spring held, hardened steel nuts. Not permitted for steam supply and condensate piping.
  - 1. Allowable hanger load: Manufacturers rating less 200 pounds.
  - 2. Guide individual pipes on the horizontal member of every other trapeze hanger with 1/4-inch U-bolt fabricated from steel rod. Provide Type 40 insulation shield, secured by two 1/2-inch galvanized steel bands, or preinsulated calcium silicate shield for insulated piping at each hanger.
- E. Supports for Piping Systems:
  - 1. Select hangers sized to encircle insulation on insulated piping. Refer to Section 23 07 11, HVAC INSULATION for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or preinsulated calcium silicate shields. Provide Type 40 insulation shield or preinsulated calcium silicate shield at all other types of supports and hangers including those for preinsulated piping.
  - 2. Convertor and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

## 2.5 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
- B. Penetrations are not allowed through beams. Any deviation from these requirements must receive prior approval of Engineer of Record and General Contractor.



- C. Sheet Metal, Plastic, or Moisture-resistant Fiber Sleeves: Provide for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- D. Cast Iron or Zinc Coated Pipe Sleeves: Provide for pipe passing through exterior walls below grade. Make space between sleeve and pipe watertight with a modular or link rubber seal. Seal shall be applied at both ends of sleeve.
- E. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- F. Sleeve Clearance: Sleeve through floors, walls, partitions, and beam flanges shall be one inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation. Interior openings shall be caulked tight with fire stopping material and sealant to prevent the spread of fire, smoke, and gases.
- G. Sealant and Adhesives: Shall be an approved type suitable for construction type.

## 2.6 DUCT PENETRATIONS

- A. Provide an approved means of firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling, or wall assembly.

## 2.7 ASBESTOS

- A. Materials containing asbestos are not permitted.

# PART 3 - EXECUTION

## 3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Coordinate location of piping, sleeves, inserts, hangers, ductwork, and equipment. Locate piping, sleeves, inserts, hangers, ductwork, and equipment clear of windows, doors, openings, light outlets, and other services and utilities. Prepare equipment for personnel access of all facilities.
- B. Equipment and Piping Support: Coordinate structural systems necessary for pipe and equipment support with pipe and equipment locations to permit proper installation.
- C. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- D. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.



- E. Electrical and Pneumatic Interconnection of Controls and Instruments: This generally not shown but must be provided. This includes interconnections of sensors, transmitters, transducers, control devices, and control. Comply with NFPA-70.
- F. Protection and Cleaning:
  - 1. Equipment and materials shall be carefully handled, properly stored, and adequately protected to prevent damage before and during installation, in accordance with the manufacturer's recommendations and as approved by the Engineer. Damaged or defective items in the opinion of the Engineer, shall be replaced.
  - 2. Protect all finished parts of equipment, such as shafts and bearings where accessible, from rust prior to operation by means of protective grease coating and wrapping. Close pipe openings with caps or plugs during installation. Tightly cover and protect fixtures and equipment against dirt, water chemical, or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials, and equipment.
- G. Concrete and Grout: Use concrete and shrink compensating grout 3,000 psi minimum.
- H. Install gages, thermometers, valves, and other devices with due regard for ease in reading or operating and maintaining said devices. Locate and position thermometers and gages to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- I. Switchgear/Electrical Equipment Drip Protection: Every effort shall be made to eliminate the installation of pipe above electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Installation of piping, ductwork, leak protection apparatus or other installations foreign to the electrical installation shall be located in the space equal to the width and depth of the equipment and extending from to a height of 6 feet above the equipment to ceiling structure, whichever is lower (NFPA 70).

### 3.2 TEMPORARY PIPING AND EQUIPMENT

- A. The Contractor shall provide all required facilities in accordance with the requirements of phased construction and maintenance of service. All piping and equipment shall be properly supported, sloped to drain, operate without excessive stress, and shall be insulated where injury can occur to personnel by contact with operating facilities. The requirements of Paragraph 3.1 apply.
- B. Temporary facilities and piping shall be completely removed and any openings in structures sealed. Provide necessary blind flanges and caps to seal open piping remaining in service.

### 3.3 PIPE AND EQUIPMENT SUPPORTS

- A. Where hanger spacing does not correspond with joist or rib spacing, use structural steel channels secured directly to joist and rib structure that will correspond to the required hanger spacing, and then suspend the equipment and piping from the channels. Drill or burn holes in structural steel only with the prior approval of the General Contractor.



- B. Use of chain, wire or strap hangers; wood for blocking, stays and bracing; or hangers suspended from piping above will not be permitted. Replace or thoroughly clean rusty products and paint with zinc primer.
- C. Use hanger rods that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. Provide a minimum of 1/2-inch clearance between pipe or piping covering and adjacent work.
- D. HVAC Horizontal Pipe Support Spacing: Provide additional supports at valves, strainers, in-line pumps and other heavy components. Provide a support within one foot of each elbow.
- E. HVAC Vertical Pipe Supports:
  - 1. Up to 6-inch pipe, 30 feet long, bolt riser clamps to the pipe below couplings, or welded to the pipe and rests supports securely on the building structure.
  - 2. Vertical pipe larger than the foregoing, support on base elbows or tees, or substantial pipe legs extending to the building structure.
- F. Overhead Supports:
  - 1. The basic structural system of the building is designed to sustain the loads imposed by equipment and piping to be supported overhead.
  - 2. Provide steel structural members of adequate capability to support the imposed loads.
- G. Floor Supports:
  - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Anchor and dowel concrete bases and structural systems to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
  - 2. Do not locate or install bases and supports until equipment mounted thereon has been approved. Size bases to match equipment mounted thereon plus 2 inch excess on all edges. Boiler foundations shall have horizontal dimensions that exceed boiler base frame dimensions by at least 6 inches on all sides. Refer to structural drawings. Bases shall be neatly finished and smoothed, shall have chamfered edges at the top, and shall be suitable for painting.
  - 3. All equipment shall be shimmed, leveled, firmly anchored, and grouted with epoxy grout. Anchor bolts shall be placed in sleeves, anchored to the bases. Fill the annular space between sleeves and bolts with a granular material to permit alignment and realignment.

### 3.4 CLEANING AND PAINTING

- A. Prior to final inspection and acceptance of the HVAC systems and components for beneficial use by the Owner the equipment and systems shall be thoroughly cleaned.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Use solvents, cleaning materials and methods recommended by the manufacturers for the specific tasks. Remove all rust from surfaces to remain unpainted. Repair scratches, scuffs, and abrasions.





### 3.5 IDENTIFICATION SIGNS

- A. Provide laminated plastic signs, with engraved lettering not less than 3/16-inch high, designating functions, for all equipment, switches, motor controllers, relays, meters, control devices, including automatic control valves. Nomenclature and identification symbols shall correspond to that used in maintenance manual, and in diagrams specified elsewhere. Attach by chain, adhesive, or screws.
- B. Factory Built Equipment: Metal plate, securely attached, with name and address of manufacturer, serial number, model number, size, performance.

### 3.6 LUBRICATION

- A. Lubricate all devices requiring lubrication prior to initial operation. Field-check all devices for proper lubrication.
- B. Equip all devices with required lubrication fittings or devices. Provide a minimum of one liter (one quart) of oil and one pound of grease of manufacturer's recommended grade and type for each different application; also provide 12 grease sticks for lubricated plug valves. Deliver all materials to Engineer in unopened containers that are properly identified as to application.
- C. All lubrication points shall be accessible without disassembling equipment, except to remove access plates.

### 3.7 STARTUP AND TEMPORARY OPERATION

- A. Startup equipment as described in equipment specifications. Verify that vibration is acceptable prior to extended operation.

### 3.9 OPERATING AND PERFORMANCE TESTS

- A. Should evidence of malfunction in any tested system, or piece of equipment or component part thereof, occur during or as a result of tests, make proper corrections, repairs or replacements, and repeat tests at no additional cost to the Owner.
- B. When completion of certain work or system occurs at a time when final control settings and adjustments cannot be properly made to make performance tests, then make performance tests for heating systems and for cooling systems respectively during first actual seasonal use of respective systems following completion of work.

END OF SECTION



## SECTION 23 05 13

### COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general purpose, horizontal, small and medium, squirrel-cage induction motors for use on AC power systems up to 600V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

##### 1.2 RELATED WORK

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

##### 1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor Controllers
  - 2. Torque, speed, and horsepower requirements of the load
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

#### PART 2 - PRODUCTS

##### 2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply With IEEE 841 for severe-duty motors.

##### 2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.



## 2.3 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20HP shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-Split Capacitor
  - 2. Split Phase
  - 3. Capacitor start, inductor run
  - 4. Capacitor start, capacitor run
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading
- D. Motors 1/20 HP and Smaller: Shaded-pole type
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

## PART 3 – EXECUTION (Not applicable)

END OF SECTION



## SECTION 23 05 29

### COMMON REQUIREMENTS FOR HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section includes:

1. Metal pipe hangers and supports
2. Trapeze pipe hangers
3. Fiberglass pipe hangers
4. Metal framing systems
5. Fiberglass strut systems
6. Thermal-hanger shield inserts
7. Fastener systems
8. Pipe stands
9. Equipment supports

##### 1.2 RELATED WORK

- ###### A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this section.
- ###### B. Install all equipment per United Facilities Criteria (UFC) 4-010-01. Specifically, section B-4.4 Standard 19. Equipment bracing:

“For all buildings required to comply with these standards mount all overhead utilities and other fixtures weighing 31 pounds or more (excluding distributed systems such as piping networks that collectively exceed that weight) using either rigid or flexible systems to minimize the likelihood that they will fall and injure building occupants. Design all equipment mountings to resist forces of 0.5 times the equipment weight in any horizontal direction and 1.5 times the equipment weight in the downward direction. This standard does not preclude the need to design equipment mountings for forces required by other criteria such as seismic standards.”

##### 1.3 DEFINITIONS

- ###### A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### 1.4 PERFORMANCE REQUIREMENTS

- ###### A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.



- B. Structural Performance: Hangers and supports for HVAC piping equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of support equipment and connected systems and components.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following: include Product Data for Components:
  - 1. Trapeze pipe hangers
  - 2. Metal framing systems
  - 3. Fiberglass strut systems
  - 4. Pipe stands
  - 5. Equipment supports
- C. Delegated-Design Submittal: For trapeze hangers indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
  - 1. Detail fabrication and assembly of trapeze hangers
  - 2. Design Calculations: Calculate requirements for designing trapeze hangers

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates

## 1.7 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, “Structural Welding Code – Steel.”
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports
  - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components
  - 2. Galvanized Metallic Coatings: Hot dipped
  - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner
  - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface or piping



5. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel

B. Copper Pipe Hangers

1. Description: MSS SP-58, Types 1 through Types 58, copper-coated-steel, factory-fabricated components
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel

## 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts

## 2.3 METAL FRAMING SYSTEMS

A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal
  - i. Allied Tube & Conduit; a part of Atkore International
  - ii. Flex-Strut Inc.
  - iii. Thomas & Betts Corporation, A Member of the ABB Group
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes
3. Standard: MFMA-4
4. Channels: Continuous slotted steel channel with interned lips
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of hot dip galvanized carbon steel or stainless steel.
7. Metallic Coating: Hot-dipped galvanized, mill galvanized In-line, hot galvanized Mechanically deposited zinc.
8. Paint Coating: Vinyl, Epoxy
9. Plastic Coating: PVC, Polyurethane

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved similar:
1. ERICO International Corporation
  2. National Pipe Hanger Corporation
  3. PHS Industries, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier
- C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig ASTM C 552, Type II cellular glass with 100-psig or



ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength

- D. For trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 Fastener Systems

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened Portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured hot dip galvanized components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration
- D. High-Type, Single-Pipe Stand:
  - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration
  - 2. Base: Stainless steel
  - 3. Vertical Members: Two or more hot dip galvanized-steel or stainless-steel, continuous-thread rods
  - 4. Horizontal Member: Hot dip galvanized-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support
- E. High-Type, Multiple-Pipe Stand
  - 1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration
  - 2. Bases: One or more; plastic
  - 3. Vertical Members: Two or more protective-coated-steel channels
  - 4. Horizontal Member: Protective-coated-steel channel



## 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers

### 2.7 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes

### 2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications
  - 1. Properties: Non-staining, noncorrosive, and nongaseous
  - 2. Design Mix: 5000-psi 28-day compressive strength

## PART 3 – EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing system
- D. Fastener System Installation
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- E. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.





2. Curb-mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb.
- F. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers and other accessories.
- G. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- H. Install hangers and supports to allow controlled thermal 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.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is places; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe sloped and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
    - i. Piping Operating below Air Ambient Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - ii. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - i. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - i. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribute plate for pipe NPS 4 and larger if pipe is installed on rollers
  4. Shield Dimensions for Pipe: Not less than the following:
    - i. NPS ¼ to NPS 3-1/2: 12 inches long and 0.048 inch thick
    - ii. NPS4: 12 inches long and 0.06 inch thick.
  5. Thermal-hanger Shields: Install with insulation same thickness as piping insulation.



### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches

### 3.5 PAINTING

- A. All hangers and supports shall be field painted to match the ceiling/wall color. Coordinate with architectural and owner

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish



- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing
- E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing
- G. Use padded hangers for piping that is subject to scratching
- H. Horizontal-Piping and Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated, stationary pipes NPS ½ to NPS 30.
  - 2. Yoke-type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS ¾ to NPS 36 requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspensions of cold and hot pipes NPS ½ to NPS 24 if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS ½ to NPS 4 to allow off center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated, stationary pipes NPS ¾ to NPS 8
  - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated, stationary pipes NPS ½ to NPS 8
  - 8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated, stationary pipes NPS ½ to NPS 8
  - 9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated, stationary pipes NPS ½ to NPS 8
  - 10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 8
  - 11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated, stationary pipes NPS 3/8 to NPS 3
  - 12. U-Bolts (MSS Type 24): For support of heavy pipes NPS ½ to NPS 30
  - 13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  - 14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  - 15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  - 16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.



17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods is longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps
1. Extension Pipe Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24
  2. Carbon or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping systems 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 installation
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe ring
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installation
- K. Building Attachments: Unless otherwise indicated and except as specified in piping system sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use on of the following for indicated loads:
    - i. Light (MSS Type 31): 750lbs
    - ii. Medium (MSS Type 32): 1500lbs
    - iii. Heavy (MSS Type 33): 3000lbs
- L. Saddles and Shields: Unless otherwise indicated and except as specified in piping systems 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. Protecting Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipes.



- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring Cushion Roll Hangers (MSS Type 49): To retard sway, shock, vibration, or thermal expansion in piping systems.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping systems from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - i. Horizontal (MSS Type 54): Mounted horizontally
    - ii. Vertical (MSS Type 55): Mounted vertically
    - iii. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping systems sections.
- P. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION



## SECTION 23 05 93

### TESTING, ADJUSTING, AND BALANCING FOR HVAC

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Testing, adjusting, and balancing (TAB) of heating, ventilating and air conditioning (HVAC) systems. TAB includes the following:
  - 1. Design Review report.
  - 2. Systems Inspection report.
  - 3. Duct Air Leakage test report.
  - 4. Balancing air and water distribution systems; adjustment of total system to provide design performance; and testing performance of equipment and automatic controls.
  - 5. Recording and reporting results.
- B. Definitions:
  - 1. Basic TAB used in this Section: Chapter 37, "Testing, Adjusting and Balancing" of 2007 ASHRAE Handbook, "HVAC Applications".
  - 2. TAB: Testing, Adjusting and Balancing; the process of checking and adjusting HVAC systems to meet design objectives.
  - 3. AABC: Associated Air Balance Council.
  - 4. NEBB: National Environmental Balancing Bureau.
  - 5. Hydronic Systems: Includes heating hot water.
  - 6. Air Systems: Includes all outside air, supply air, return air, exhaust air and relief air systems.
  - 7. Flow rate tolerance: The allowable percentage variation, minus to plus, of actual flow rate from values (design) in the contract documents.

##### 1.2 RELATED WORK

- A. Section 23 05 11, Common Work Results for HVAC: General Mechanical Requirements.
- B. Section 23 07 11, HVAC Insulation: Piping and Equipment Insulation.
- C. Section 23 31 00, HVAC Ducts and Casings: Duct Leakage.
- D. Section 23 37 00, Air Outlets and Inlets.
- E. Section 23 82 00, Convection Heating and Cooling Units.

##### 1.3 QUALITY ASSURANCE

- A. Qualifications:
  - 1. The TAB agency shall be either a certified member of AABC or certified by the NEBB to perform TAB service for HVAC, water balancing. The certification shall be maintained for the entire duration of duties specified herein.



2. All TAB technicians performing actual TAB work shall be experienced and must have done satisfactory work on a minimum of 3 projects comparable in size and complexity to this project. Qualifications must be certified by the TAB agency in writing. The lead technician shall be certified by AABC or NEBB
- B. Test Equipment Criteria: The instrumentation shall meet the accuracy/calibration requirements established by AABC National Standards or by NEBB Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems and instrument manufacturer. Provide calibration history of the instruments to be used for test and balance purpose.
- C. TAB Criteria:
1. One or more of the applicable AABC, NEBB or SMACNA publications, supplemented by ASHRAE Handbook "HVAC Applications" Chapter 36, and requirements stated herein shall be the basis for planning, procedures, and reports.
  2. Flow rate tolerance: Following tolerances are allowed. For tolerances not mentioned herein follow ASHRAE Handbook "HVAC Applications", Chapter 36, as a guideline. Air Filter resistance during tests, artificially imposed, if necessary, shall be at least 100 percent of manufacturer recommended change over pressure drop values for pre-filters and after-filters.
    - a. Air handling unit and all other fans, cubic feet per minute: Minus 0 percent to plus 10 percent.
    - b. Air terminal units (maximum values): Minus 2 percent to plus 10 percent.
    - c. Exhaust hoods: 0 percent to plus 10 percent.
    - d. Minimum outside air: 0 percent to plus 10 percent.
    - e. Individual room air outlets and inlets, and air flow rates not mentioned above: Minus 5 percent to plus 10 percent except if the air to space is 100 CFM or less the tolerance would be minus 5 to plus 5 percent.
    - f. Heating hot water pumps and hot water coils: Minus 5 percent to plus 5 percent.
  3. Systems shall be adjusted for energy efficient operation as described in PART 3.

#### 1.4 SUBMITTALS

- A. Submit names and qualifications of TAB agency.
- B. Submit Following for Review and Approval:
1. Design Review Report within 60 days of completion of project after the system layout on air and water side is completed by the Contractor.
  2. Duct Air Leakage Test Report.
  3. Final TAB reports covering flow balance and adjustments, performance tests.
  4. Include in final reports uncorrected installation deficiencies noted during TAB and applicable explanatory comments on test results that differ from design requirements.
- C. Prior to request for Final inspection, submit completed Test and Balance report for the area.



## 1.5 APPLICABLE PUBLICATIONS

- A. The following publications form a part of this specification to the extent indicated by the reference thereto. In text the publications are referenced to by the acronym of the organization.
- B. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):
  - 2007 .....HVAC Applications ASHRAE Handbook, Chapter 37, Testing, Adjusting, and Balancing and Chapter 47, Sound and Vibration Control
- C. Associated Air Balance Council (AABC):
  - 2002.....AABC National Standards for Total System Balance
- D. National Environmental Balancing Bureau (NEBB):
  - 7<sup>th</sup> Edition 2005.....Procedural Standards for Testing, Adjusting, Balancing of Environmental Systems
  - 2nd Edition 2006 .....Procedural Standards for the Measurement of Sound and Vibration
  - 3<sup>rd</sup> Edition 2009 Procedural Standards for Whole Building Systems Commissioning of New Construction
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
  - 3<sup>rd</sup> Edition 2002.....HVAC Systems Testing, Adjusting and Balancing

## PART 2 - PRODUCTS

### 2.1 PLUGS

- A. Provide plastic plugs to seal holes drilled in ductwork for test purposes.

### 2.2 INSULATION REPAIR MATERIAL

- A. Provide for repair of insulation removed or damaged for TAB work.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Refer to TAB Criteria in Article, Quality Assurance.
- B. Obtain applicable contract documents and copies of approved submittals for HVAC equipment and automatic control systems.

### 3.2 SYSTEMS INSPECTION REPORT

- A. Inspect equipment and installation for conformance with design.





- B. Reports: Follow check list format developed by AABC, NEBB or SMACNA, supplemented by narrative comments, with emphasis on air handling units and fans. Check for conformance with submittals. Verify that diffuser and register sizes are correct. Check air terminal unit installation including their duct sizes and routing.

### 3.3 DUCT AIR LEAKAGE TEST REPORT

- A. TAB Agency shall perform the leakage test as outlined in "Duct leakage Tests and Repairs" in Section 23 31 00, HVAC Ducts and Casings for TAB agency's role and responsibilities in witnessing, recording, and reporting of deficiencies.

### 3.4 SYSTEM READINESS REPORT

- A. Inspect each System to ensure that it is complete including installation and operation of controls. Submit report to Engineer in standard format.
- B. Verify that all items such as ductwork piping, ports, terminals, connectors, etc., that is required for TAB are installed.

### 3.5 TAB PROCEDURES

- A. Tab shall be performed in accordance with the requirement of the Standard under which TAB agency is certified by either AABC or NEBB.
- B. General: During TAB all related system components shall be in full operation. Fan and pump rotation, motor loads and vibration shall be checked and corrected as necessary before proceeding with TAB. Set controls and/or block off parts of distribution systems to simulate design operation of variable volume air or water systems for test and balance work.
- C. Air Balance and Equipment Test: Include air handling units, fans, terminal units, fan coil units, room diffusers/outlets/inlets, kitchen hoods and exhaust fans.
  - 1. Artificially load air filters by partial blanking to produce air pressure drop of manufacturer's recommended pressure drop.
  - 2. Adjust fan speeds to provide design air flow. V-belt drives, including fixed pitch pulley requirements.
  - 3. Test and balance systems in all specified modes of operation, including variable volume, economizer, and fire emergency modes. Verify that dampers and other controls function properly.
  - 4. Record final measurements for air handling equipment performance data sheets.

### 3.6 MARKING OF SETTINGS

- A. Following approval of Tab final Report, the setting of all HVAC adjustment devices including valves, splitters and dampers shall be permanently marked by the TAB Specialist so that adjustment can be restored if disturbed at any time.



### 3.7 IDENTIFICATION OF TEST PORTS

- A. The TAB Specialist shall permanently and legibly identify the location points of duct test ports. If the ductwork has exterior insulation, the identification shall be made on the exterior side of the insulation. All penetrations through ductwork and ductwork insulation shall be sealed to prevent air leaks and maintain integrity of vapor barrier.

END OF SECTION



## SECTION 23 07 11

### HVAC INSULATION

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for:
  - 1. HVAC piping, ductwork and equipment.
- B. Definitions
  - 1. ASJ: All service jacket, white finish facing or jacket.
  - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
  - 3. Cold: Equipment, ductwork or piping handling media at design temperature of 60 degrees F or below.
  - 4. Concealed: Ductwork and piping above ceilings and in chases, and pipe spaces.
  - 5. Exposed: Piping, ductwork, and equipment exposed to view in finished areas including mechanical and electrical equipment rooms or exposed to outdoor weather. Attics and crawl spaces where air handling units are located are considered to be mechanical rooms. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  - 6. FSK: Foil-scrim-kraft facing.
  - 7. Hot: HVAC Ductwork handling air at design temperature above 60 degrees F; HVAC equipment or piping handling media above 105 degrees F.
  - 8. Density:  $\text{kg/m}^3$  - kilograms per cubic meter (Pcf - pounds per cubic foot).
  - 9. Runouts: Branch pipe connections up to one-inch nominal size to fan coil units or reheat coils for terminal units.
  - 10. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: Watt per square meter (BTU per hour per square foot).
    - b. Pipe or Cylinder: Watt per square meter (BTU per hour per linear foot).
  - 11. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
  - 12. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permeance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permeance of 0.1 perms and vapor barriers shall have a maximum published permeance of 0.001 perms.
  - 13. HWS: Hot water heating supply.
  - 14. HWR: Hot water heating return.
  - 15. R: Refrigerant liquid or suction.

##### 1.2 RELATED WORK

- A. Section 23 05 11, Common Work Results for HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.



B. Section 23 23 00, Refrigerant Piping

C. Section 23 31 00, HVAC Ducts and Casings: Ductwork, plenum and fittings.

### 1.3 QUALITY ASSURANCE

A. Criteria:

1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, duct coverings, duct linings, vapor retarder facings, adhesives, fasteners, tapes, and supplementary materials added to air ducts, plenums, panels, and duct silencers used in duct systems, unless otherwise provided for in 4.3.3.1.1 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (*See 4.2.4.2.*)

4.3.3.1.2 The flame spread and smoke developed index requirements of 4.3.3.1.1 shall not apply to air duct weatherproof coverings where they are located entirely outside of a building, do not penetrate a wall or roof, and do not create an exposure hazard.

4.3.3.2 Closure systems for use with rigid and flexible air ducts tested in accordance with UL 181, Standard for Safety Factory-Made Air Ducts and Air Connectors, shall have been tested, listed, and used in accordance with the conditions of their listings, in accordance with one of the following:

- (1) UL 181A, Standard for Safety Closure Systems for Use with Rigid Air Ducts and Air Connectors
- (2) UL 181B, Standard for Safety Closure Systems for Use with Flexible Air Ducts and Air Connectors

4.3.3.3 Air duct, panel, and plenum coverings and linings, and pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 250°F.

4.3.3.4 Air duct coverings shall not extend through walls or floors that are required to be fire stopped or required to have a fire resistance rating, unless such coverings meet the requirements of 5.4.6.4.

4.3.3.5\* Air duct linings shall be interrupted at fire dampers to prevent interference with the operation of devices.

4.3.3.6 Air duct coverings shall not be installed so as to conceal or prevent the use of any service opening.



4.3.10.2.6 Materials exposed to the airflow shall be noncombustible or limited combustible and have a maximum smoke developed index of 50 or comply with the following.

4.3.10.2.6.1 Electrical wires and cables and optical fiber cables shall be listed as noncombustible or limited combustible and have a maximum smoke developed index of 50 or shall be listed as having a maximum peak optical density of 0.5 or less, an average optical density of 0.15 or less, and a maximum flame spread distance of 1.5 m (5 ft) or less when tested in accordance with NFPA 262, Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.

4.3.10.2.6.6 Supplementary materials for air distribution systems shall be permitted when complying with the provisions of 4.3.3.

5.4.6.4 Where air ducts pass through walls, floors, or partitions that are required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall be as follows:

- (1) Not exceeding a 25.4 mm (1 in.) average clearance on all sides
- (2) Filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when subjected to the time-temperature fire conditions required for fire barrier penetration as specified in NFPA 251, *Standard Methods of Tests of Fire Endurance of Building Construction and Materials*

2. Test methods: ASTM E84, UL 723, or NFPA 255.

3. Specified k factors are at 75 degrees F mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

B. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

C. See Section 23 05 11, Common Work Results for HVAC, Article 1.7 Quality Assurance.

## 1.4 SUBMITTALS

A. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM.
  - a. Insulation materials: Specify each type used and state surface burning characteristics.
  - b. Insulation facings and jackets: Each type used. Make it clear that white finish will be furnished for exposed ductwork, casings and equipment.
  - c. Insulation accessory materials: Each type used.



- d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
- e. Make reference to applicable specification paragraph numbers for coordination.

B. See Section 23 05 11, Common Work Results for HVAC, Article 1.4 Submittals for further requirements.

## 1.5 STORAGE AND HANDLING OF MATERIAL

- A. Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

## 1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.

- B. American Society for Testing and Materials (ASTM):

A167-99(2004).....	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
B209-07.....	Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
C411-05.....	Standard test method for Hot-Surface Performance of High-Temperature Thermal Insulation
C449-07.....	Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement
C533-09.....	Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
C534-08.....	Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
C547-07.....	Standard Specification for Mineral Fiber pipe Insulation
C552-07.....	Standard Specification for Cellular Glass Thermal Insulation
C553-08.....	Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
C585-09.....	Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System) R (1998)
C612-10.....	Standard Specification for Mineral Fiber Block and Board Thermal Insulation
C1126-04.....	Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
C1136-10.....	Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
D1668-97a (2006).....	Standard Specification for Glass Fabrics (Woven and Treated) for Roofing and Waterproofing



- E84-10.....Standard Test Method for Surface Burning Characteristics of Building Materials
- E119-09c.....Standard Test Method for Fire Tests of Building Construction and Materials
- E136-09b.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)
- C. National Fire Protection Association (NFPA):
  - 90A-09 .....Standard for the Installation of Air Conditioning and Ventilating Systems
  - 96-08 .....Standards for Ventilation Control and Fire Protection of Commercial Cooking Operations
  - 101-09 .....Life Safety Code
  - 251-06 .....Standard methods of Tests of Fire Endurance of Building Construction Materials
  - 255-06 .....Standard Method of tests of Surface Burning Characteristics of Building Materials
- D. Underwriters Laboratories, Inc (UL):
  - 723.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 09/08
- E. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):
  - SP58-2009.....Pipe Hangers and Supports Materials, Design, and Manufacture

## PART 2 - PRODUCTS

### 2.1 FIBER GLASS

- A. ASTM C612 (Board, Block), Class 1 or 2, density 3 pcf,  $k = 0.26$  at 75 degrees F, external insulation for temperatures up to 400 degrees F with foil scrim (FSK) facing.
- B. ASTM C553 (Blanket, Flexible) Type I, // Class B-3, Density 1 pcf  $k = 0.31$  // Class B-5, Density 2 pcf,  $k = 0.27$  // at 75 degrees F, for use at temperatures up to 400 degrees F with foil scrim (FSK) facing.
- C. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1,  $k = 0.037$  (0.26) at 24 degrees C (75 degrees F), for use at temperatures up to 230 degrees C (450 degrees F) with an all service vapor retarder jacket with polyvinyl chloride premolded fitting covering.

### 2.2 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

- A. ASTM C177, C518,  $k = 0.27$  at 75 degrees F, flame spread not over 25, smoke developed not over 50, for temperatures from minus 40 degrees F to 200 degrees F. No jacket required.



## 2.3 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance  $\leq 0.02$  or less perm rating, Beach puncture 50 units for insulation facing on exposed ductwork, casings and equipment, and for pipe insulation jackets. Facings and jackets shall be all service type (ASJ) or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 1 mil thick aluminum foil, fiberglass reinforced, with pressure sensitive adhesive closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for painting without sizing. Jackets shall have minimum 1-1/2 inch lap on longitudinal joints and minimum 3 inch butt strip on end joints. Butt strip material shall be same as the jacket. Lap and butt strips shall be self-sealing type with factory-applied pressure sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK) or PVDC vapor retarder jacketing type for concealed ductwork and equipment.
- D. Field applied vapor barrier jackets shall be provided, in addition to the specified facings and jackets, on all exterior piping and ductwork as well as on interior piping and ductwork exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.) in high humidity areas. The vapor barrier jacket shall consist of a multi-layer laminated cladding with a maximum water vapor permeance of 0.001 perms. The minimum puncture resistance shall be 30 inch-pounds for interior locations and 80 inch-pounds for exterior or exposed locations or where the insulation is subject to damage.
- E. Glass Cloth Jackets: Presized, minimum 0.18 kg per square meter (7.8 ounces per square yard), 300 psig bursting strength with integral vapor retarder where required or specified. Weatherproof if utilized for outside service.
- F. Factory composite materials may be used provided that they have been tested and certified by the manufacturer.
- G. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.03 inches. Provide color matching vapor retarder pressure sensitive tape.
- H. Aluminum Jacket-Piping systems// and circular breeching and stacks//: ASTM B209, 3003 alloy, H-14 temper, 0.023 inch minimum thickness with locking longitudinal joints. Jackets for elbows, tees and other fittings shall be factory-fabricated to match shape of fitting and of 0.024 inch minimum thickness aluminum. Fittings shall be of same construction as straight run jackets but need not be of the same alloy. Factory-fabricated stainless steel bands shall be installed on all circumferential joints. Bands shall be 0.5 inch wide on 18 inch centers. System shall be weatherproof if utilized for outside service.





- I. Aluminum jacket-Rectangular breeching: ASTM B209, 3003 alloy, H-14 temper, 0.020 inches thick with 1-1/4 inch corrugations or 0.032 inches thick with no corrugations. System shall be weatherproof if used for outside service.

## 2.4 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size inches	Insert Blocks inches
Up through 5	6 long
6	6 long
8, 10, 12	9 long
14, 16	12 long
418 through 24	14 long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 300 degrees F), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 3.0 pcf.

## 2.5 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-3316, Class 2: Adhesive for laps and for adhering insulation to metal surfaces.
- C. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- D. Mil. Spec. MIL-C-19565, Type I: Protective finish for outdoor use.
- E. Mil. Spec. MIL-C-19565, Type I or Type II: Vapor barrier compound for indoor use.
- F. ASTM C449: Mineral fiber hydraulic-setting thermal insulating and finishing cement.
- G. Other: Insulation manufacturers' published recommendations.

## 2.6 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel-coated or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel.



- C. Wire: 18 gage soft annealed galvanized or 14 gage copper clad steel or nickel copper alloy.
- D. Bands: 0.5-inch nominal width, brass, galvanized steel, aluminum or stainless steel.

## 2.7 REINFORCEMENT AND FINISHES

- A. Glass fabric, open weave: ASTM D1668, Type III (resin treated) and Type I (asphalt treated).
- B. Glass fiber fitting tape: Mil. Spec MIL-C-20079, Type II, Class 1.
- C. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- D. Hexagonal wire netting: one inch mesh, 22 gage galvanized steel.
- E. Corner beads: 2 inch by 2 inch, 26 gage galvanized steel; or 1 inch by 1 inch, 28 gage aluminum angle adhered to 2 inch by 2 inch Kraft paper.
- F. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 40 degrees F to 250 degrees F. Below 40 degrees F and above 250 degrees F. Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

## 2.8 FLAME AND SMOKE

- A. Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA, and UL standards and specifications.

## PART 3 - EXECUTION

### 3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of duct and piping joints and connections shall be completed and the work approved by the Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate entire specified equipment, piping (pipe, fittings, valves, accessories), and duct systems. Insulate each pipe and duct individually. Do not use scrap pieces of insulation where a full-length section will fit.
- C. Insulation materials shall be installed in a first-class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings, except at fire dampers and duct heaters (NFPA 90A). Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 60 degrees F and below. Lap and seal vapor retarder over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 6 inches.



- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Construct insulation on parts of equipment such as chilled water pumps and heads of chillers, convertors and heat exchangers that must be opened periodically for maintenance or repair, so insulation can be removed and replaced without damage. Install insulation with bolted (20 gage galvanized steel or aluminum covers as complete units, or in sections, with all necessary supports, and split to coincide with flange/split of the equipment.
- F. Insulation on hot piping and equipment shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- G. Protect all insulations outside of buildings with aluminum jacket using lock joint or other approved system for a continuous weather tight system. Access doors and other items requiring maintenance or access shall be removable and sealable.
- H. HVAC work not to be insulated:
  - 1. Internally insulated ductwork and air handling units.
- I. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.
- J. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights. The elbow/fitting insulation shall be field-fabricated, mitered or factory prefabricated to the necessary size and shape to fit on the elbow/ fitting. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Provide vapor barrier jackets over insulation as follows:
  - 1. All piping and ductwork exposed to outdoor weather.
  - 2. All interior piping and ducts conveying fluids exposed to outdoor air (i.e., in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature.
- L. Provide metal jackets over insulation as follows:
  - 1. All piping and ducts exposed to outdoor weather.
  - 2. A 2-inch overlap is required at longitudinal and circumferential joints.

### 3.2 INSULATION INSTALLATION

- A. Mineral Fiber Board:
  - 1. Faced board: Apply board on pins spaced not more than 12 inches on center each way, and not less than 3 inches from each edge of board. In addition to pins, apply insulation bonding adhesive to entire underside of horizontal metal surfaces. Butt insulation edges tightly and seal all joints with laps and butt strips. After applying speed clips cut pins off flush and apply vapor seal patches over clips.



2. Plain board:
    - a. Insulation shall be scored, beveled or mitered to provide tight joints and be secured to equipment with bands spaced 9 inches on center for irregular surfaces or with pins and clips on flat surfaces. Use corner beads to protect edges of insulation.
    - b. For hot equipment: Stretch 1 inch mesh wire, with edges wire laced together, over insulation and finish with insulating and finishing cement applied in one coat, 1/4 inch thick, trowel led to a smooth finish.
    - c. For cold equipment: Apply meshed glass fabric in a tack coat 60 to 70 square feet per gallon of vapor mastic and finish with mastic at 2 to 15 square feet per gallon over the entire fabric surface.
    - d. Chilled water pumps: Insulate with removable and replaceable 20 gage aluminum or galvanized steel covers lined with insulation. Seal closure joints/flanges of covers with gasket material. Fill void space in enclosure with flexible mineral fiber insulation.
  3. Exposed, unlined ductwork and equipment in unfinished areas, mechanical and electrical equipment rooms and attics, and duct work exposed to outdoor weather:
    - a. 2-inch-thick insulation faced with ASJ (white all service jacket): Supply air duct and after filter housing.
    - b. 2-inch-thick insulation faced with ASJ: Return air duct, mixed air plenums and prefilter housing.
    - c. Outside air intake ducts: // no insulation required // one-inch-thick insulation faced with ASJ.
    - d. Exposed, unlined supply and return ductwork exposed to outdoor weather: 2-inch-thick insulation faced with a reinforcing membrane and two coats of vapor barrier mastic or multi-layer vapor barrier with a maximum water vapor permeability of 0.001 perms.
  4. Cold equipment: 1-1/2-inch-thick insulation faced with ASJ.
    - a. Chilled water pumps, water filter, chemical feeder pot or tank.
    - b. Pneumatic, cold storage water and surge tanks.
  5. Hot equipment: 1-1/2-inch-thick insulation faced with ASJ.
    - a. Convertors, air separators, steam condensate pump receivers.
    - b. Reheat coil casing and separation chambers on steam humidifiers located above ceilings.
    - c. Domestic water heaters and hot water storage tanks (not factory insulated).
    - d. Booster water heaters for dietetics dish and pot washers and for washdown grease-extracting hoods.
- B. Flexible Mineral Fiber Blanket:
1. Adhere insulation to metal with 3 inch wide strips of insulation bonding adhesive at 8 inches on center all around duct. Additionally secure insulation to bottom of ducts exceeding 24 inches in width with pins welded or adhered on 18 inch centers. Secure washers on pins. Butt insulation edges and seal joints with laps and butt strips. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations with mastic. Sagging duct insulation will not be acceptable. Install firestop duct insulation where required.
  2. Supply air ductwork to be insulated includes main and branch ducts from AHU discharge to room supply outlets, and the bodies of ceiling outlets to prevent condensation. Insulate sound attenuator units, coil casings and damper frames. To



prevent condensation, insulate trapeze type supports and angle iron hangers for flat oval ducts that are in direct contact with metal duct.

3. Concealed supply air ductwork.
  - a. Above ceilings at a roof level, in attics, and duct work exposed to outdoor weather: 2 inch thick insulation faced with FSK.
  - b. Above ceilings for other than roof level: 1 ½ inch thick insulation faced with FSK.
4. Concealed return air duct:
  - a. In attics (where not subject to damage) and where exposed to outdoor weather: Two inch) thick insulation faced with FSK.
  - b. Above ceilings at a roof level, unconditioned areas, and in chases with external wall or containing steam piping; 1-1/2 inch thick, insulation faced with FSK.
  - c. In interstitial spaces (where not subject to damage): 1-1/2 inch thick insulation faced with FSK.
  - d. Concealed return air ductwork in other locations need not be insulated.
5. Concealed outside air duct: 1-1/2 inch thick insulation faced with FSK.
6. Exhaust air branch duct from autopsy refrigerator to main duct: 1-1/2 inch thick insulation faced with FSK.

C. Molded Mineral Fiber Pipe and Tubing Covering:

1. Fit insulation to pipe or duct, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
  - a. Insulating and finishing cement for sizes less than 4 inches operating at surface temperature of 61 degrees F or more.
  - b. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 40 degrees F, or above 250 degrees F. Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
  - c. Factory molded, ASTM C547 or field mitered sections, joined with adhesive or wired in place. For hot piping finish with a smoothing coat of finishing cement. For cold fittings, 60 degrees F or less, vapor seal with a layer of glass fitting tape imbedded between two 1/16 inch coats of vapor barrier mastic.
  - d. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 2 inches.
3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

G. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions and finish with two coats of weather resistant finish as recommended by the insulation manufacturer.
2. Pipe and tubing insulation:
  - a. Use proper size material. Do not stretch or strain insulation.



- b. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer. Insulation shields are specified under Section 23 05 11, Common Work Results for HVAC //and Section 23 05 10, Common Work Results for Boiler Plant and Steam Generation//.
  - c. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.
3. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
4. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section.
5. Minimum 0.75 inch thick insulation for pneumatic control lines for a minimum distance of 20 feet from discharge side of the refrigerated dryer.
6. Use Class S (Sheet), 3/4 inch thick for the following:
  - a. Chilled water pumps
  - b. Bottom and sides of metal basins for winterized cooling towers (where basin water is heated).
  - d. Piping inside refrigerators and freezers: Provide heat tape under insulation.
7. Exposed, unlined supply and return ductwork exposed to outdoor weather: Two inch thick insulation faced with a multi-layer vapor barrier with a water vapor permeance of 0.00 perms.

### 3.3 PIPE INSULATION SCHEDULE

Insulation Thickness Inches					
		Nominal Pipe Size (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 1	1-1¼	(1½-3)	4 and Above
100-200 degrees F (HWS, HWR)	Mineral Fiber (Above ground piping only)	1.5	1.5	2.0	2.0
Refrigerant Piping	Flexible Elastomeric Cellular Insulation	.75	.75	1	1.5

END OF SECTION



## SECTION 23 21 13

### HYDRONIC PIPING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Water piping to connect HVAC equipment, including the following:
  - 1. Heating hot water and drain piping.

##### 1.2 RELATED WORK

- A. Section 23 05 11, Common Work Results for HVAC.
- B. Section 23 07 11, HVAC Insulation.
- C. Section 23 23 00, Refrigerant Piping.
- D. Section 23 82 00, Heat Terminal Units.
- E. Section 23 09 23, Direct-Digital Control System for HVAC.

##### 1.3 QUALITY ASSURANCE

- A. Section 23 05 11, Common Work Results for HVAC.

##### 1.4 SUBMITTALS

- A. Manufacturer's Literature and Data:
  - 1. Pipe and equipment supports.
  - 2. Pipe and tubing, with specification, class or type, and schedule.
  - 3. Pipe fittings, including miscellaneous adapters and special fittings.
  - 4. Flanges, gaskets and bolting.
  - 5. Valves of all types.
  - 6. Strainers.
  - 7. All specified hydronic system components.
  - 8. Gages.
  - 9. Thermometers and test wells.
- B. See Section 23 05 11, Common Work Results for HVAC, Article 1.4 Submittals for further requirements.



## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only. American National Standards Institute, Inc.
- B. American Society of Mechanical Engineers/American National Standards Institute, Inc. (ASME/ANSI):
- B1.20.1-83(R2006) .....Pipe Threads, General Purpose (Inch)
  - B16.4-06.....Gray Iron Threaded Fittings
  - B16.18-01.....Cast Copper Alloy Solder joint Pressure fittings
  - B16.23-02.....Cast Copper Alloy Solder joint Drainage fittings
  - B40.100-05.....Pressure Gauges and Gauge Attachments
- C. American National Standards Institute, Inc./Fluid Controls Institute (ANSI/FCI):
- 70-2-2006.....Control Valve Seat Leakage
- D. American Society of Mechanical Engineers (ASME):
- B16.1-98.....Cast Iron Pipe Flanges and Flanged Fittings
  - B16.3-2006.....Malleable Iron Threaded Fittings: Class 150 and 300
  - B16.4-2006.....Gray Iron Threaded Fittings: (Class 125 and 250)
  - B16.5-2003.....Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24  
Metric/Inch Standard
  - B16.9-07.....Factory Made Wrought Butt Welding Fittings
  - B16.11-05.....Forged Fittings, Socket Welding and Threaded
  - B16.18-01.....Cast Copper Alloy Solder Joint Pressure Fittings
  - B16.22-01.....Wrought Copper and Bronze Solder Joint Pressure Fittings.
  - B16.24-06.....Cast Copper Alloy Pipe Flanges and Flanged Fittings
  - B16.39-06.....Malleable Iron Threaded Pipe Unions
  - B16.42-06.....Ductile Iron Pipe Flanges and Flanged Fittings
  - B31.1-08.....Power Piping
- E. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (2004) .....Ferritic Malleable Iron Castings
  - A53/A53M-07 .....Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
  - A106/A106M-08.....Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
  - A126-04 .....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
  - A183-03 .....Standard Specification for Carbon Steel Track Bolts and Nuts
  - A216/A216M-08 .....Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High Temperature Service
  - A234/A234M-07 .....Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service
  - A307-07 .....Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength





- A536-84 (2004) ..... Standard Specification for Ductile Iron Castings
- A615/A615M-08 ..... Deformed and Plain Carbon Steel Bars for Concrete Reinforcement
- A653/A 653M-08 ..... Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) By the Hot-Dip Process
- B32-08..... Standard Specification for Solder Metal
- B62-02..... Standard Specification for Composition Bronze or Ounce Metal Castings
- B88-03..... Standard Specification for Seamless Copper Water Tube
- B209-07..... Aluminum and Aluminum Alloy Sheet and Plate
- C177-04 ..... Standard Test Method for Steady State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus
- C478-09..... Precast Reinforced Concrete Manhole Sections
- C533-07..... Calcium Silicate Block and Pipe Thermal Insulation
- C552-07..... Cellular Glass Thermal Insulation
- D3350-08 ..... Polyethylene Plastics Pipe and Fittings Materials
- C591-08..... Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
- D1784-08 ..... Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compound
- D1785-06 ..... Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
- D2241-05 ..... Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
- F439-06 ..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
- F441/F441M-02..... Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
- F477-08 ..... Elastomeric Seals Gaskets) for Joining Plastic Pipe
- F. American Water Works Association (AWWA):
- C110-08..... Ductile Iron and Grey Iron Fittings for Water
- C203-02..... Coal Tar Protective Coatings and Linings for Steel Water Pipe Lines Enamel and Tape Hot Applied
- G. American Welding Society (AWS):
- B2.1-02..... Standard Welding Procedure Specification
- H. Copper Development Association, Inc. (CDA):
- CDA A4015-06..... Copper Tube Handbook
- I. Expansion Joint Manufacturer's Association, Inc. (EJMA):
- EMJA-2003..... Expansion Joint Manufacturer's Association Standards, Ninth Edition



- J. Manufacturers Standardization Society (MSS) of the Valve and Fitting Industry, Inc.:
  - SP-67-02a.....Butterfly Valves
  - SP-70-06 .....Gray Iron Gate Valves, Flanged and Threaded Ends
  - SP-71-05 .....Gray Iron Swing Check Valves, Flanged and Threaded Ends
  - SP-80-08 .....Bronze Gate, Globe, Angle and Check Valves
  - SP-85-02 .....Cast Iron Globe and Angle Valves, Flanged and Threaded Ends
  - SP-110-96 .....Ball Valves Threaded, Socket-Welding, Solder Joint, and Flared Ends
  - SP-125-00 .....Gray Iron and Ductile Iron In-line, Spring Loaded, Center-Guided Check Valves
- K. National Sanitation Foundation/American National Standards Institute, Inc. (NSF/ANSI):
  - 14-06 .....Plastic Piping System Components and Related Materials
  - 50-2009a .....Equipment for Swimming Pools, Spas, Hot Tubs and other Recreational Water Facilities – Evaluation criteria for materials, components, products, equipment and systems for use at recreational water facilities
  - 61-2008 .....Drinking Water System Components – Health Effects
- L. Tubular Exchanger Manufacturers Association: TEMA 9th Edition, 2007

## PART 2 - PRODUCTS

### 2.1 PIPE AND EQUIPMENT SUPPORTS, PIPE SLEEVES, AND WALL AND CEILING PLATES

- A. Provide in accordance with Section 23 05 11, Common Work Results for HVAC.

### 2.2 PIPE AND TUBING

- A. Heating Hot Water and Vent Piping:
  - 1. Steel: ASTM A53 Grade B, seamless or ERW, Schedule 40.
  - 2. Copper water tube: ASTM B88, Type K (underground) or L (aboveground), hard drawn.
- B. Cooling Coil Condensate Drain Piping:
  - 1. From air handling units and evap units: Copper water tube, ASTM B88, Type M, or schedule 40 PVC plastic piping.
- C. Pipe supports, including insulation shields, for above ground piping: Section 23 05 11, Common Work Results for HVAC.



## 2.3 FITTINGS FOR STEEL PIPE

- A. Two inches and Smaller: Screwed or welded joints.
  - 1. Butt welding: ASME B16.9 with same wall thickness as connecting piping.
  - 2. Forged steel, socket welding or threaded: ASME B16.11.
  - 3. Screwed: 150 pound malleable iron, ASME B16.3. 125 pound cast iron, ASME B16.4, may be used in lieu of malleable iron. Bushing reduction of a single pipe size, or use of close nipples, is not acceptable.
  - 4. Unions: ASME B16.39.
  - 5. Water hose connection adapter: Brass, pipe thread to 3/4 inch garden hose thread, with hose cap nut.
- B. Two and one-half inches and Larger: Welded or flanged joints.
  - 1. Butt welding fittings: ASME B16.9 with same wall thickness as connecting piping. Elbows shall be long radius type, unless otherwise noted.
  - 2. Welding flanges and bolting: ASME B16.5:
    - a. Water service: Weld neck or slip-on, plain face, with 1/8 inch thick full face neoprene gasket suitable for 220 degrees F.
      - 1) Contractor's option: Convuluted, cold formed 150 pound steel flanges, with teflon gaskets, may be used for water service.
    - b. Flange bolting: Carbon steel machine bolts or studs and nuts, ASTM A307, Grade
- C. Welded Branch and Tap Connections: Forged steel weldolets, or branchlets and threadolets may be used for branch connections up to one pipe size smaller than the main. Forged steel half-couplings, ASME B16.11 may be used for drain, vent and gage connections.

## 2.4 FITTINGS FOR COPPER TUBING

- A. Joints:
  - 1. Solder Joints: Joints shall be made up in accordance with recommended practices of the materials applied. Apply 95/5 tin and antimony on all copper piping.
  - 2. Mechanically formed tee connection in water and drain piping: Form mechanically extracted collars in a continuous operation by drilling pilot hole and drawing out tube surface to form collar, having a height of not less than three times the thickness of tube wall. Adjustable collaring device shall insure proper tolerance and complete uniformity of the joint. Notch and dimple joining branch tube in a single process to provide free flow where the branch tube penetrates the fitting.
- B. Bronze Flanges and Flanged Fittings: ASME B16.24.
- C. Fittings: ANSI/ASME B16.18 cast copper or ANSI/ASME B16.22 solder wrought copper.

## 2.5 FITTINGS FOR PLASTIC PIPING

- A. Schedule 40, socket type for solvent welding.
- B. Schedule 40 PVC drain piping: Drainage pattern.



## 2.6 DIELECTRIC FITTINGS

- A. Provide where copper tubing and ferrous metal pipe are joined.
- B. Two inches and Smaller: Threaded dielectric union, ASME B16.39.
- C. Two and one-half inches and Larger: Flange union with dielectric gasket and bolt sleeves, ASME B16.42.
- D. Temperature Rating, 210 degrees F.

## 2.7 SCREWED JOINTS

- A. Pipe Thread: ANSI B1.20.
- B. Lubricant or Sealant: Oil and graphite or other compound approved for the intended service.

## 2.8 VALVES

- A. Asbestos packing is not acceptable.
- B. All valves of the same type shall be products of a single manufacturer.
- C. Shut-Off Valves
  - 1. Ball Valves (Pipe sizes 2" and smaller): screwed or solder connections, brass or bronze body with chrome-plated ball with full port and Teflon seat at (400 psig) working pressure rating. Provide stem extension to allow operation without interfering with pipe insulation.
- D. Globe and Angle Valves
  - 1. Globe Valves
    - a. Two inches and smaller: MSS-SP 80, bronze, 150 lb. Globe valves shall be union bonnet with metal plug type disc.
    - b. Two and one-half inches and larger: 125 psig, flanged, iron body, bronze trim, MSS-SP-85 for globe valves.
  - 2. Angle Valves:
    - a. Two inches and smaller: bronze, 150 lb. Angle valves shall be union bonnet with metal plug type disc.
    - b. Two and one-half inches and larger: 125 psig, flanged, iron body, bronze trim, for angle.
- E. Check Valves
  - 1. Swing Check Valves:
    - a. Two inches and smaller: bronze, 150 lb., 45 degree swing disc.
    - b. Two and one-half inches and larger: 125 psig, flanged, iron body, bronze trim.



2. Non-Slam or Silent Check Valve: Spring loaded double disc swing check or internally guided flat disc lift type check for bubble tight shut-off. Provide where check valves are shown in chilled water and hot water piping. Check valves incorporating a balancing feature may be used.
  - a. Body: cast iron, ASTM A126, Class B, or steel, ASTM A216, Class WCB, or ductile iron, ASTM 536, flanged, or wafer type.
  - b. Seat, disc and spring: 18-8 stainless steel, or bronze, ASTM B62. Seats may be elastomer material.
- F. Water Flow Balancing Valves: For flow regulation and shut-off. Valves shall be line size rather than reduced to control valve size.
  1. Ball or Globe style valve.

## 2.9 STRAINERS

- A. Y Type.
  1. Screens: Bronze, monel metal or 18-8 stainless steel, free area not less than 2-1/2 times pipe area, with perforations as follows: 0.045 inch diameter perforations for 4 inches and larger: 0.125 inch diameter perforations.

## 2.10 HYDRONIC SYSTEM COMPONENTS

- A. Pressure Reducing Valve (Water): Diaphragm or bellows operated, spring loaded type, with minimum adjustable range of 4 psig above and below set point. Bronze, brass or iron body and bronze, brass or stainless steel trim, rated 125 psig working pressure at 225 degrees F.
- B. Pressure Relief Valve: Bronze or iron body and bronze or stainless steel trim, with testing lever. Comply with ASME Code for Pressure Vessels, Section 8, and bear ASME stamp.
- C. Automatic Air Vent Valves (locate at highest elevation of piping per circuit)- Cast iron or semi-steel body, 150 psig working pressure, stainless steel float, valve, valve seat and mechanism, minimum 1/2 inch water connection and 1/4 inch air outlet.

## 2.11 GAGES, PRESSURE AND COMPOUND

- A. ASME B40.100, Accuracy Grade 1A, (pressure, vacuum, or compound for air, oil or water), initial mid-scale accuracy 1 percent of scale (Qualify grade), metal or phenolic case, 4-1/2 inches) in diameter, 1/4 inch NPT bottom connection, white dial with black graduations and pointer, clear glass or acrylic plastic window, suitable for board mounting. Provide red "set hand" to indicate normal working pressure.
- B. Range of Gages: Provide range equal to at least 130 percent of normal operating range.



## 2.12 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, norden self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.

## 2.13 THERMOMETERS

- A. Mercury or organic liquid filled type, red or blue column, clear plastic window, with 6 inch brass stem, straight, fixed or adjustable angle as required for each in reading.
- B. Case: Chrome plated brass or aluminum with enamel finish.
- C. Scale: Not less than 9 inches, range as described below, two degree graduations.
- D. Separable Socket (Well): Brass, extension neck type to clear pipe insulation.
- E. Scale ranges:
  - 1. Hot Water: 30-240 degrees F.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. The drawings show the general arrangement of pipe and equipment but do not show all required fittings and offsets that may be necessary to connect pipes to equipment, fan-coils, coils, radiators, etc., and to coordinate with other trades. Provide all necessary fittings, offsets and pipe runs based on field measurements and at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories to be connected on ceiling grid. Pipe location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.
- B. Store materials to avoid excessive exposure to weather or foreign materials. Keep inside of piping relatively clean during installation and protect open ends when work is not in progress.
- C. Support piping securely. Refer to PART 3, Section 23 05 11, Common Work Results for HVAC.
- D. Install piping generally parallel to walls and column center lines, unless shown otherwise on the drawings. Space piping, including insulation, to provide one inch minimum clearance between adjacent piping or other surface. Unless shown otherwise, slope drain piping down in the direction of flow not less than one inch in 40 feet. Provide eccentric reducers to keep bottom of sloped piping flat.



- E. Locate and orient valves to permit proper operation and access for maintenance of packing, Locate and orient valves to permit proper operation and access for maintenance of packing, seat and disc. Generally locate valve stems in overhead piping in horizontal position. Provide a union adjacent to one end of all threaded end valves. Control valves usually require reducers to connect to pipe sizes shown on the drawing. Install butterfly valves with the valve open as recommended by the manufacturer to prevent binding of the disc in the seat.
- F. Offset equipment connections to allow valving off for maintenance and repair with minimal removal of piping. Provide flexibility in equipment connections and branch line take-offs.
- G. Tee water piping runouts or branches into the side of mains or other branches.
- H. Provide manual or automatic air vent at all piping system high points and drain valves at all low points.
- I. Connect piping to equipment as shown on the drawings. Install components furnished by others such as:
  - J. Thermometer Wells: In pipes 2-1/2 inches and smaller increase the pipe size to provide free area equal to the upstream pipe area.
  - K. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.
  - L. Where copper piping is connected to steel piping, provide dielectric connections.

### 3.2 PIPE JOINTS

- A. Welded: Beveling, spacing and other details shall conform to ASME B31.1 and AWS B2.1. See Welder's qualification requirements under "Quality Assurance" in Section 23 05 11, Common Work Results for HVAC.
- B. Screwed: Threads shall conform to ASME B1.20; joint compound shall be applied to male threads only and joints made up so no more than three threads show. Coat exposed threads on steel pipe with joint compound, or red lead paint for corrosion protection.
- C. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
- D. Solvent Welded Joints: As recommended by the manufacturer.



### 3.3 LEAK TESTING ABOVEGROUND PIPING

- A. Inspect all joints and connections for leaks and workmanship and make corrections as necessary, to the satisfaction of the Engineer. Tests may be either of those below, or a combination, as approved by the Engineer.
- B. An operating test at design pressure, and for hot systems, design maximum temperature.
- C. A hydrostatic test at 1.5 times design pressure. For water systems the design maximum pressure would usually be the static head, or expansion tank maximum pressure, plus pump head. Factory tested equipment (convertors, exchangers, coils, etc.) need not be field tested. Isolate equipment where necessary to avoid excessive pressure on mechanical seals and safety devices.

END OF SECTION





## SECTION 23 23 00

### REFRIGERANT PIPING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Refrigerant piping shall be sized, selected, and designed either by the equipment manufacturer or in strict accordance with the manufacturer's published instructions. The schematic piping diagram shall show all accessories such as, stop valves, level indicators, liquid receivers, oil separator, gauges, thermostatic expansion valves, solenoid valves, moisture separators and driers to make a complete installation.
- B. Definitions:
  - 1. Refrigerating system: Combination of interconnected refrigerant-containing parts constituting one closed refrigeration circuit in which a refrigerant is circulated for the purpose of extracting heat.
    - a. Low side means the parts of a refrigerating system subjected to evaporator pressure.
    - b. High side means the parts of a refrigerating system subjected to condenser pressure.
  - 2. Brazed joint: A gas-tight joint obtained by the joining of metal parts with alloys which melt at temperatures higher than 840 degrees) but less than the melting temperatures of the joined parts.

##### 1.2 RELATED WORK

- A. Section 23 05 11, Common Work Results For HVAC: General mechanical requirements and items, which are common to more than one section of Division 23.

##### 1.3 QUALITY ASSURANCE

- A. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration. The application of this Code is intended to assure the safe design, construction, installation, operation, and inspection of every refrigerating system employing a fluid which normally is vaporized and liquefied in its refrigerating cycle.
- B. Comply with ASME B31.5: Refrigerant Piping and Heat Transfer Components.
- C. Products shall comply with UL 207 "Refrigerant-Containing Components and Accessories, "Nonelectrical"; or UL 429 "Electrical Operated Valves."
- D. See Section 23 05 11, Common Work Results For HVAC, Article 1.7 Quality Assurance.



## 1.4 SUBMITTALS

- A. Shop Drawings:
1. Complete information for components noted, including valves and refrigerant piping accessories, clearly presented, shall be included to determine compliance with drawings and specifications for components noted below:
    - a. Tubing and fittings
    - b. Valves
    - c. Strainers
    - d. Moisture-liquid indicators
    - e. Filter-driers
    - f. Flexible metal hose
    - g. Liquid-suction interchanges
    - h. Oil separators (when specified)
    - i. Gages
    - j. Pipe and equipment supports
    - k. Refrigerant and oil
    - l. Pipe/conduit roof penetration cover
    - m. Soldering and brazing materials
- B. See Section 23 05 11, Common Work Results For HVAC, Article 1.4 Submittals for further requirements.

## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Conditioning, Heating, and Refrigeration Institute (ARI/AHRI):
- 495-1999 (R2002).....Standard for Refrigerant Liquid Receivers
  - 730-2005 .....Flow Capacity Rating of Suction-Line Filters and Suction-Line Filter-Driers
  - 750-2007 .....Thermostatic Refrigerant Expansion Valves
  - 760-2007 .....Performance Rating of Solenoid Valves for Use with Volatile Refrigerants
- C. American Society of Heating Refrigerating and Air Conditioning Engineers (ASHRAE):
- ANSI/ASHRAE 15-2007 ....Safety Standard for Refrigeration Systems (ANSI)
  - ANSI/ASHRAE 17-2008 ....Method of Testing Capacity of Thermostatic Refrigerant Expansion Valves (ANSI)
  - 63.1-95 (RA 01) .....Method of Testing Liquid Line Refrigerant Driers (ANSI)
- D. American National Standards Institute (ANSI):
- ASME (ANSI)A13.1-2007 ....Scheme for Identification of Piping Systems
  - Z535.1-2006 .....Safety Color Code



- E. American Society of Mechanical Engineers (ASME):
  - ANSI/ASME B16.22-2001 (R2005)  
Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings (ANSI)
  - ANSI/ASME B16.24-2006 Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500 (ANSI)
  - ANSI/ASME B31.5-2006.....Refrigeration Piping and Heat Transfer Components (ANSI)
  - ANSI/ASME B40.100-2005 .....Pressure Gauges and Gauge Attachments
  - ANSI/ASME B40.200-2008 .....Thermometers, Direct Reading and Remote Reading
- F. American Society for Testing and Materials (ASTM)
  - A126-04 .....Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
  - B32-08 .....Standard Specification for Solder Metal
  - B88-03.....Standard Specification for Seamless Copper Water Tube
  - B88M-05 .....Standard Specification for Seamless Copper Water Tube (Metric)
  - B280-08.....Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
- G. American Welding Society, Inc. (AWS):
  - Brazing Handbook
  - A5.8/A5.8M-04.....Standard Specification for Filler Metals for Brazing and Braze Welding
- H. Federal Specifications (Fed. Spec.)
  - Fed. Spec. GG
- I. Underwriters Laboratories (U.L.):
  - U.L.207-2009 .....Standard for Refrigerant-Containing Components and Accessories, Nonelectrical
  - U.L.429-99 (Rev.2006).....Standard for Electrically Operated Valves

## PART 2 - PRODUCTS

### 2.1 PIPING AND FITTINGS

- A. Refrigerant Piping: Copper Tubing, ASTM B88, Type K, annealed.
- B. Fittings, Valves and Accessories:
  - 1. Joints: Flared.
  - 2. Refrigeration Valves:
    - a. Stop Valves: Brass or bronze alloy, packless, or packed type with gas tight cap, frost proof, back seating.

### 2.2 PIPE SUPPORTS

- A. Refer to specification Section 23 05 11, Common Work Results for HVAC.



## 2.3 REFRIGERANTS AND OIL

- A. Provide EPA approved refrigerant and oil for proper system operation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install refrigerant piping and refrigerant containing parts in accordance with ASHRAE Standard 15 and ASME B31.5
  1. Install piping as short as possible, with a minimum number of joints, elbow and fittings.
  2. Install piping with adequate clearance between pipe and adjacent walls and hangers to allow for service and inspection. Space piping, including insulation, to provide 25 mm (1 inch) minimum clearance between adjacent piping or other surface. Use pipe sleeves through walls, floors, and ceilings, sized to permit installation of pipes with full thickness insulation.
  3. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.
- B. Joint Construction:
  1. Ream pipe and tube ends. Remove burrs.
  2. Remove scale and dirt on inside and outside before assembly.
  3. Prepare piping connections to equipment with flanges.
  4. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- C. Protect refrigerant system during construction against entrance of foreign matter, dirt and moisture; have open ends of piping and connections to compressors, condensers, evaporators and other equipment tightly capped until assembly.
- D. Pipe relief valve discharge to outdoors for systems containing more than 100 lbs of refrigerant.
- E. Firestopping: Fill openings around uninsulated piping penetrating floors or fire walls, with firestop material.

### 3.2 PIPE AND TUBING INSULATION

- A. Refer to specification Section 23 07 11, HVAC Insulation.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.
- C. Provide and install slim-duct up exterior of building to route refrigerant and condensate drain piping. Coordinate color requirement with Architect/Engineer.



### 3.3 SIGNS AND IDENTIFICATION

- A. Each refrigerating system erected on the premises shall be provided with an easily legible permanent sign securely attached and easily accessible, indicating thereon the name and address of the installer, the kind and total number of pounds of refrigerant required in the system for normal operations, and the field test pressure applied.

### 3.4 FIELD QUALITY CONTROL

- A. Prior to initial operation examine and inspect piping system for conformance to plans and specifications and ASME B31.5. Correct equipment, material, or work rejected because of defects or nonconformance with plans and specifications, and ANSI codes for pressure piping.
- B. After completion of piping installation and prior to initial operation, conduct test on piping system according to ASME B31.5. Furnish materials and equipment required for tests. If the test fails, correct defects and perform the test again until it is satisfactorily done, and all joints are proved tight.
  - 1. Every refrigerant-containing parts of the system that is erected on the premises, except compressors, condensers, evaporators, safety devices, pressure gages, control mechanisms and systems that are factory tested, shall be tested and proved tight after complete installation, and before operation.
  - 2. The high and low side of each system shall be tested and proved tight at not less than the lower of the design pressure or the setting of the pressure-relief device protecting the high or low side of the system, respectively, except systems erected on the premises using non-toxic and non-flammable Group A1 refrigerants with copper tubing not exceeding DN 18 (NPS 5/8). This may be tested by means of the refrigerant charged into the system at the saturated vapor pressure of the refrigerant at 68 degrees F minimum.
- C. Test Medium: A suitable dry gas such as nitrogen or shall be used for pressure testing. The means used to build up test pressure shall have either a pressure-limiting device or pressure-reducing device with a pressure-relief device and a gage on the outlet side. The pressure relief device shall be set above the test pressure but low enough to prevent permanent deformation of the system components.

### 3.5 SYSTEM TEST AND CHARGING

- A. System Test and Charging: As recommended by the equipment manufacturer.

END OF SECTION



## SECTION 23 31 00

### HVAC DUCTS AND CASINGS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Ductwork and accessories for HVAC including the following:
  - 1. Outside air, Exhaust air, Return air, and Supply air.
- B. Definitions:
  - 1. SMACNA Standards as used in this specification means the HVAC Duct Construction Standards, Metal and Flexible.
  - 2. Seal or Sealing: Use of liquid or mastic sealant, with or without compatible tape overlay, or gasketing of flanged joints, to keep air leakage at duct joints, seams and connections to an acceptable minimum.
  - 3. Duct Pressure Classification: SMACNA HVAC Duct Construction Standards, Metal and Flexible.
  - 4. Exposed Duct: Exposed to view in a finished room and exposed to weather.

##### 1.2 RELATED WORK

- A. General Mechanical Requirements: Section 23 05 11, Common Work Results for HVAC.
- B. Duct Insulation: Section 23 07 11, HVAC Insulation.

##### 1.3 QUALITY ASSURANCE

- A. Fire Safety Code: Comply with NFPA 90A.
- B. Duct System Construction and Installation: Referenced SMACNA Standards are the minimum acceptable quality.
- C. Duct Sealing, Air Leakage Criteria, and Air Leakage Tests: Ducts shall be sealed as per duct sealing requirements of SMACNA HVAC Air Duct Leakage Test Manual for duct pressure classes shown on the drawings.
- D. Duct accessories exposed to the air stream, such as dampers of all types (except smoke dampers) and access openings, shall be of the same material as the duct or provide at least the same level of corrosion resistance.
- E. See Section 23 05 11, Common Work Results For HVAC, Article 1.7 Quality Assurance.

##### 1.4 SUBMITTALS

- A. Manufacturer's Literature and Data:
  - 1. Volume dampers, back draft dampers.
  - 2. Flexible connections.
- B. See Section 23 05 11, Common Work Results For HVAC, Article 1.4 Submittals for further requirements.



## 1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Civil Engineers (ASCE):
  - ASCE7-05 .....Minimum Design Loads for Buildings and Other Structures
- C. American Society for Testing and Materials (ASTM):
  - A167-99(2009).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
  - A653-09 .....Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy coated (Galvannealed) by the Hot-Dip process
  - A1011-09a.....Standard Specification for Steel, Sheet and Strip, Hot rolled, Carbon, structural, High-Strength Low-Alloy, High Strength Low-Alloy with Improved Formability, and Ultra-High Strength
  - B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - C1071-05e1.....Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material)
  - E84-09a.....Standard Test Method for Surface Burning Characteristics of Building Materials
- D. National Fire Protection Association (NFPA):
  - 90A-09.....Standard for the Installation of Air Conditioning and Ventilating Systems
  - 96-08.....Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations
- E. Sheet Metal and Air Conditioning Contractors National Association (SMACNA):
  - 2nd Edition – 2005.....HVAC Duct Construction Standards, Metal and Flexible
  - 1st Edition - 1985.....HVAC Air Duct Leakage Test Manual
  - 6th Edition – 2003.....Fibrous Glass Duct Construction Standards
- F. Underwriters Laboratories, Inc. (UL):
  - 181-08 .....Factory-Made Air Ducts and Air Connectors
  - 555-06 .....Standard for Fire Dampers
  - 555S-06 .....Standard for Smoke Dampers

## PART 2 - PRODUCTS

### 2.1 DUCT MATERIALS AND SEALANTS

- A. General: Except for systems specified otherwise, construct ducts, casings, and accessories of galvanized sheet steel, ASTM A653, coating G90; or, aluminum sheet, ASTM B209, alloy 1100, 3003, or 5052.



- B. Joint Sealing: Refer to SMACNA HVAC Duct Construction Standards, paragraph S1.9.
  - 1. Sealant: Elastomeric compound, gun or brush grade, maximum 25 flame spread, and 50 smoke developed (dry state) compounded specifically for sealing ductwork as recommended by the manufacturer. Generally, provide liquid sealant, with or without compatible tape, for low clearance slip joints and heavy, permanently elastic, mastic type where clearances are larger. Oil base caulking and glazing compounds are not acceptable because they do not retain elasticity and bond.
  - 2. Tape: Use only tape specifically designated by the sealant manufacturer and apply only over wet sealant. Pressure sensitive tape shall not be used on bare metal or on dry sealant.
  - 3. Gaskets in Flanged Joints: Soft neoprene.
- C. Approved factory made joints may be used.

## 2.2 DUCT CONSTRUCTION AND INSTALLATION

- A. Regardless of the pressure classifications outlined in the SMACNA Standards, fabricate, and seal the ductwork in accordance with the following pressure classifications:
- B. Seal Class: All ductwork shall receive Class A Seal
- C. Volume Dampers: Single blade or opposed blade, multi-louver type as detailed in SMACNA Standards. Refer to SMACNA Detail Figure 2-12 for Single Blade and Figure 2.13 for Multi-blade Volume Dampers.
- C. Duct Hangers and Supports: Refer to SMACNA Standards Section IV. Avoid use of trapeze hangers for round duct.

## 2.3 DUCT ACCESS DOORS, PANELS AND SECTIONS

- A. Provide access doors, sized and located for maintenance work, upstream, in the following locations:
  - 1. Motorized dampers.
- B. Openings shall be as large as feasible in small ducts, 12 inch by 12 inch minimum where possible. Access sections in insulated ducts shall be double-wall, insulated. Transparent shatterproof covers are preferred for uninsulated ducts.
  - 1. For rectangular ducts: Refer to SMACNA HVAC Duct Construction Standards (Figure 2-12).
  - 2. For round and flat oval duct: Refer to SMACNA HVAC duct Construction Standards (Figure 2-11).

## 2.4 FLEXIBLE DUCT CONNECTIONS

- A. Where duct connections are made to fans, air terminal units, and air handling units, install a non-combustible flexible connection of 29 ounce neoprene coated fiberglass fabric approximately 6 inches wide. For connections exposed to sun and weather provide hypalon coating in lieu of neoprene. Burning characteristics shall conform to NFPA 90A. Securely fasten flexible connections to round ducts with stainless steel or zinc-coated





iron draw bands with worm gear fastener. For rectangular connections, crimp fabric to sheet metal and fasten sheet metal to ducts by screws 2 inches on center. Fabric shall not be stressed other than by air pressure. Allow at least one inch slack to insure that no vibration is transmitted.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, Common Work Results for HVAC, particularly regarding coordination with other trades.
- B. Fabricate and install ductwork and accessories in accordance with referenced SMACNA Standards:
  - 1. Drawings show the general layout of ductwork and accessories but do not show all required fittings and offsets that may be necessary to connect ducts to equipment, boxes, diffusers, grilles, etc., and to coordinate with other trades. Fabricate ductwork based on field measurements. Provide all necessary fittings and offsets at no additional cost to the Owner. Coordinate with other trades for space available and relative location of HVAC equipment and accessories on ceiling grid. Duct sizes on the drawings are inside dimensions which shall be altered by Contractor to other dimensions with the same air handling characteristics where necessary to avoid interferences and clearance difficulties.
  - 2. Provide duct transitions, offsets and connections to dampers, coils, and other equipment in accordance with SMACNA Standards, Section II. Provide streamliner when an obstruction cannot be avoided and must be taken in by a duct. Repair galvanized areas with galvanizing repair compound.
  - 3. Provide bolted construction and tie-rod reinforcement in accordance with SMACNA Standards.
  - 4. Construct casings, eliminators, and pipe penetrations in accordance with SMACNA Standards, Chapter 6. Design casing access doors to swing against air pressure so that pressure helps to maintain a tight seal.
- C. Install duct hangers and supports in accordance with SMACNA Standards, Chapter 4.
- D. Flexible duct installation: Flexible duct shall only be used as indicated on plans and limited to a maximum of 3 feet. If flexible duct is clearly shown on plans hard duct shall be used.
- E. Control Damper Installation:
  - 1. Provide necessary blank-off plates required to install dampers that are smaller than duct size. Provide necessary transitions required to install dampers larger than duct size.
  - 2. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.
- F. Protection and Cleaning: Adequately protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by Engineer. Protect equipment and ducts during



construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting. When new ducts are connected to existing ductwork, clean both new and existing ductwork by mopping and vacuum cleaning inside and outside before operation.

END OF SECTION



## SECTION 23 37 00

### AIR OUTLETS AND INLETS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Air Outlets and Inlets: Diffusers, Grilles, and Louvers.

##### 1.2 RELATED WORK

- A. General Mechanical Requirements: Section 23 05 11, Common Work Results for HVAC.

##### 1.3 SUBMITTALS

- A. Manufacturer's Literature and Data:
  - 1. Air intake/exhaust louvers.
  - 2. Diffusers, registers, grilles and accessories.
- B. See Section 23 05 11, Common Work Results for HVAC, Article 1.4 Submittals for further requirements.

##### 1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Diffusion Council Test Code:
  - 1062 GRD-84.....Certification, Rating, and Test Manual 4<sup>th</sup> Edition
- C. American Society of Civil Engineers (ASCE):
  - ASCE7-05 .....Minimum Design Loads for Buildings and Other Structures
- D. American Society for Testing and Materials (ASTM):
  - A167-99 (2004).....Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
  - B209-07.....Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- E. National Fire Protection Association (NFPA):
  - 90A-09 .....Standard for the Installation of Air Conditioning and Ventilating Systems
- F. Underwriters Laboratories, Inc. (UL):
  - 181-08 .....UL Standard for Safety Factory-Made Air Ducts and Connectors



## PART 2 - PRODUCTS

### 2.1 AIR OUTLETS AND INLETS

- A. Materials:
  - 1. Aluminum, unless scheduled/noted otherwise. Use aluminum air outlets and inlets for facilities located in high-humidity areas. Provide manufacturer's standard gasket.
  - 2. Exposed Fastenings: The same material as the respective inlet or outlet. Fasteners for aluminum may be stainless steel.
- B. Air Supply Outlets:
  - 1. As scheduled on drawings.
- C. Return and Exhaust Registers and Grilles:
  - 1. As scheduled on drawings.

### 2.2 LOUVERS

- A. As scheduled on drawings.
- B. Provide with Kynar finish, color TBD by engineer/architect. Provide with bird/insect screen.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with provisions of Section 23 05 11, Common Work Results for HVAC, particularly regarding coordination with other trades.
- B. Protection and Cleaning: Protect equipment and materials against physical damage. Place equipment in first class operating condition or return to source of supply for repair or replacement, as determined by Resident Engineer. Protect equipment during construction against entry of foreign matter to the inside and clean both inside and outside before operation and painting.

END OF SECTION



## SECTION 23 72 00

### AIR-TO-AIR ENERGY RECOVERY EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Packaged energy/heat recovery units.

##### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.
  - 1. Wiring Diagrams: For power, signal, and control wiring.

##### 1.4 INFORMATION SUBMITTALS

- A. 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. Suspended ceiling components.
  - 2. Structural members to which equipment or suspension systems will be attached.
- B. Field quality-control reports.

##### 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-to-air energy recovery equipment to include maintenance manuals.

##### 1.6 CLOSEOUT SUBMITTALS

- 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. ARI Compliance:
  - 1. Capacity ratings for air-to-air energy recovery equipment shall comply with ARI 1060, "Performance Rating of Air-to-Air Heat Exchangers for Energy Recovery Ventilation Equipment."



2. Capacity ratings for air coils shall comply with ARI 410, "Forced-Circulation Air- Cooling and Air-Heating Coils."
- C. UL Compliance:
  1. Packaged heat recovery ventilators shall comply with requirements in UL 1812, "Ducted Heat Recovery Ventilators"; or UL 1815, "Nonducted Heat Recovery Ventilators."

## 1.7 COORDINATION

- A. Coordinate layout and installation of air-to-air energy recovery equipment and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided.
- C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

## 1.8 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of air-to-air energy recovery equipment that fail in materials or workmanship within specified warranty period.
  1. Warranty Period for Packaged Energy Recovery Units: Two years.
  2. Warranty Period for Fixed-Plate Total Heat Exchangers: 10 years.

## PART 2 – PRODUCTS

### 2.1 PACKAGED ENERGY/HEAT RECOVERY VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following or similar:
  1. Renewaire.
  2. Approved equal.
- B. Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
- C. Third party certified to AHRI 1060.
- D. Capable of sensible and latent energy recovery Energy Transfer
- E. Passive frost control without condensing at -10F outside air, 40% rh return air.



- F. Designed for continuous operation.
- G. Casing: 20 gauge, G-90 galvanized. Walls and doors shall be insulated with 1 inch, 4 pound density, foil/scrim faced, high-density fiberglass board insulation, providing a cleanable surface and eliminating the possibility of exposing the fresh air to glass fibers, and with minimum R- value of 4.3 (hr·ft<sup>2</sup>·°F/BTU).
- H. Access Doors: Provide access doors for boilers, cores and air filters. Airtight compression seal. Pressure taps with plugs shall be provided allowing for core pressure drop measurement and airflow calculation.
- I. Drain Pan: Not allowed. Unit shall operate without condensation formation.
- J. Plates: Evenly spaced and sealed and arranged for cross or counter airflow.
  - 1. Plate Material: Molecular transport through hygroscopic resin. Porous plate or metal plate cores shall not be allowed.
- K. Disposable Panel Filters (both airstreams):
  - 1. Comply with NFPA 90A.
  - 2. Filter Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lift out from access plenum.
  - 3. Factory-fabricated, viscous-coated, flat-panel type.
  - 4. Thickness: 2 inches.
  - 5. Minimum Arrestance: 80, according to ASHRAE 52.1.
  - 6. MERV: 8 according to ASHRAE 52.2.
  - 7. Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
  - 8. Frame: Galvanized steel with metal grid on outlet side, steel rod grid on inlet side, hinged, and with pull and retaining handles.
- L. Electrical and controls: Single point power connection with factory installed disconnect and single factory's integral controls per plans.
- M. Blower Motors/Fans: Premium efficiency, EISA compliant. TEFC with factory installed starters. Forward curved fans with adjustable pulleys and motor mounts for speed adjustment. Motors shall be inverter ready.
- N. Variable Frequency Drives: Provide VFDs or ECM motors/controls for each fan.
- O. Dampers: Provide low leakage, insulated, spring return, motorized isolation dampers on both airstreams.



## 2.2 CONTROLS

- A. Refer to sequence of operations on drawings.
- B. Units will operate during occupied hours based on CO2 demand controlled ventilation.
- C. Units shall be schedulable through their standalone controls.
- D. See plans for units requiring economizing bypass mode & controls.

## PART 3 – EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine casing insulation materials and filter media before air-to-air energy recovery equipment installation. Reject insulation materials and filter media that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for electrical services to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install duct access doors in both supply and exhaust ducts, both upstream and downstream, for access to heat exchanger.
- B. Mounting Units: Suspend units from structural-steel support frame using threaded steel rods and spring hangers sized by the manufacturer.
  - 1. Install units with clearances for service and maintenance.
  - 2. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.
- C. Provide flexible duct connections at unit duct flanges.
- D. Provide straight, gradual transition ductwork for a minimum of 2.5 duct diameters downstream from the blower outlet to minimize duct noise.

### 3.3 CONNECTIONS

- A. Install electrical devices furnished with units but not factory mounted.





### 3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Tests and Inspections:
  - 1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
  - 2. Adjust seals and purge.
  - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  - 4. Set initial temperature and CO2 set points per controls sequence drawings.
  - 5. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- D. Air-to-air energy recovery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

### 3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air-to-air energy recovery units.

END OF SECTION



## SECTION 23 81 29

### VARIABLE-REFRIGERANT-FLOW HVAC SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. The requirements of Section 23 00 00, "Basic Mechanical Requirements" apply to work defined by this Section.
- C. The requirements of Section 23 05 00, "Basic Mechanical Materials and Methods" apply to work defined by this Section.

##### 1.2 SUMMARY

- A. Section includes complete VRF HVAC system(s) including, but not limited to the following components to make a complete operating system(s) according to requirements indicated:
  - 1. Indoor, recessed, ceiling-mounted units.
  - 2. Outdoor, air-source, heat-pump units.
  - 3. Outdoor, air-source heat recovery units.
  - 4. Heat recovery control units.
  - 5. System controls.
  - 6. Pipe stands.
  - 7. Equipment stands.
  - 8. Miscellaneous support materials.
  - 9. System control cable and raceways.

##### 1.3 DEFINITIONS

- A. Air-Conditioning System Operation: System capable of operation with all zones in cooling only.
- B. Heat-Pump System Operation: System capable of operation with all zones in either heating or cooling, but not with simultaneous heating and cooling zones that transfer heat between zones.
- C. Heat Recovery System Operation: System capable of operation with simultaneous heating and cooling zones that transfer heat between zones.
- D. HRCU: Heat Recovery Control Unit. HRCUs are used in heat recovery VRF HVAC systems to manage and control refrigerant between indoor units to provide simultaneous heating and cooling zones. "Heat Recovery Control Unit" is the term used by ASHRAE for what different manufacturers term as branch circuit controller, branch selector box, changeover box, flow selector unit, mode change unit, and other such terms.
- E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.



- G. Two-Pipe System Design: One refrigerant vapor line and one refrigerant liquid line connect a single outdoor unit or multiple manifold outdoor units in a single system to associated system HRCUs. One refrigerant liquid line and refrigerant vapor line connect HRCUs to associated indoor units. HRCUs used in two pipe systems act as an intermediate heat exchanger and include diverting valves and gas/liquid separators to move high and low pressure refrigerant between indoor units.
- H. VRF: Variable refrigerant flow.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for indoor and outdoor units and for HRCUs.
  - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - 3. Include operating performance at design conditions and at extreme maximum and minimum outdoor ambient conditions.
  - 4. Include description of system controllers, dimensions, features, control interfaces and connections, power requirements, and connections.
  - 5. Include total refrigerant required and a comprehensive breakdown of refrigerant required by each system installed.
  - 6. Include refrigerant type and data sheets showing compliance with requirements indicated.
  - 7. Indicate location and type of service access.
- B. Source quality-control reports.
- C. Field quality-control reports.
- D. Sample Warranties: For manufacturer's warranties.
- E. Operation and Maintenance Data: For VRF HVAC systems to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
  - 1. Nationally recognized manufacturer of VRF HVAC systems and products.
  - 2. Shipped VRF HVAC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
  - 3. VRF HVAC systems and products that have been successfully tested and in use on at least three completed projects.
  - 4. Having complete published catalog literature, installation, and operation and maintenance manuals for all products intended for use.
  - 5. Having full-time in-house employees for the following:
    - a. Product research and development.
    - b. Product and application engineering.
    - c. Product manufacturing, testing, and quality control.
    - d. Technical support for system installation training, startup, commissioning, and troubleshooting of installations.
    - e. Owner training.



- B. **Installer Qualifications:** An entity that employs installers and supervisors who are trained and approved by VRF HVAC system manufacturer.
  - 1. Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, piping, controls, and accessories indicated and furnished for installation.
  - 2. Installer certification shall be valid and current for duration of Project.
  - 3. Retain copies of Installer certificates on-site and make available on request.
  - 4. Each person assigned to Project shall have demonstrated past experience.
    - a. Demonstrated past experience with products being installed for period within three consecutive years before time of bid.
    - b. Demonstrated past experience on five projects of similar complexity, scope, and value.
- C. **ISO Compliance:** System equipment and components furnished by VRF HVAC system manufacturer shall be manufactured in an ISO 9001 and ISO 14001 facility.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store products in a clean and dry place.
- B. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
- C. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
- D. Protect products from weather, dirt, dust, water, construction debris, and physical damage.
  - 1. Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.
  - 2. Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.
- E. Replace installed products damaged during construction.

#### 1.7 WARRANTY

- A. **Manufacturer's Warranty:** Manufacturer agrees to repair or replace equipment and components that fail(s) in materials or workmanship within specified warranty period.
  - 1. **Warranty Period:**
    - a. For Compressor: Five year(s) from date of Substantial Completion.
    - b. For Parts, Including Controls: Five year(s) from date of Substantial Completion.
    - c. For Labor: Five year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. **Source Limitations:** Obtain products from single source from single manufacturer including, but not limited to, the following:
  - 1. Indoor and outdoor units, including accessories.
  - 2. Controls and software.



3. Branch controllers/Branch boxes.
4. Other proprietary piping accessories.

## 2.2 SYSTEM DESCRIPTION

- A. Direct-expansion (DX) VRF HVAC system(s) with variable capacity in response to varying cooling and heating loads. System shall consist of multiple indoor units, HRCUs, outdoor unit(s), piping, controls, and electrical power to make complete operating system(s) complying with requirements indicated.
  1. Two-pipe system design.
  2. System(s) operation, heat recovery & heat pump as indicated on Drawings.
  3. Each system with one refrigerant circuit shared by all indoor units connected to system.
- 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. AHRI Compliance: System and equipment performance certified according to AHRI 1230 and products listed in AHRI directory.
- D. ASHRAE Compliance:
  1. ASHRAE 15: For safety code for mechanical refrigeration.
  2. ASHRAE 62.1: For indoor air quality.
  3. ASHRAE 135: For control network protocol with remote communication.
  4. ASHRAE/IES 90.1 Compliance: For system and component energy efficiency.
- E. UL Compliance: Comply with UL 1995.

## 2.3 PERFORMANCE REQUIREMENTS

- A. Isolation of Equipment: Provide isolation valves to isolate each branch controller, branch box, indoor unit and outdoor unit for service, removal, and replacement without interrupting system operation.
- B. System Capacity Ratio: The sum of connected capacity of all indoor units shall be within the following range of outdoor-unit rated capacity:
  1. Range acceptable to manufacturer.
  2. Range acceptable as to not increase heating and cooling output derates from design derate.
- C. Capacities and Characteristics: As indicated on Drawings.

## 2.4 INDOOR, EXPOSED, WALL-MOUNTED UNITS

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
- B. Cabinet:
  1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
  2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  3. Mounting: Manufacturer-designed provisions for field installation.



4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
1. Coil Casing: Aluminum, galvanized, or stainless steel.
  2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  3. Coil Tubes: Copper, of diameter and thickness required by performance.
  4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  5. Unit Internal Tubing: Copper tubing with brazed joints.
  6. Unit Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  7. Field Piping Connections: Manufacturer's standard.
  8. Factory Charge: Dehydrated air or nitrogen.
  9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  2. Condensate Removal: Gravity.
    - a. If a floor drain is not available at unit, provide unit with field-installed condensate pump accessory.
  3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    - d. Wheels statically and dynamically balanced.
  2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
  5. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Filter Assembly:
1. Access: Front, to accommodate filter replacement without the need for tools.
  2. Washable Media: Manufacturer's standard filter with antimicrobial treatment.
- G. Grille Assembly: Manufacturer's standard discharge grille mounted on the front face of unit cabinet.



## 2.5 INDOOR, RECESSED, CEILING-MOUNTED UNITS

- A. Description: Factory-assembled complete unit with components, piping, wiring, and controls required for mating to ductwork, piping, power, and controls field connections.
- B. Cabinet:
  - 1. Material: Painted steel, or coated steel frame covered by a plastic cabinet, with an architectural acceptable finish suitable for tenant occupancy on exposed surfaces.
  - 2. Insulation: Manufacturer's standard internal insulation, complying with ASHRAE 62.1, to provide thermal resistance and prevent condensation.
  - 3. Mounting: Manufacturer-designed provisions for field installation.
  - 4. Internal Access: Removable panels of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. DX Coil Assembly:
  - 1. Coil Casing: Aluminum, galvanized, or stainless steel.
  - 2. Coil Fins: Aluminum, mechanically bonded to tubes, with arrangement required by performance.
  - 3. Coil Tubes: Copper, of diameter and thickness required by performance.
  - 4. Expansion Valve: Electronic modulating type with linear or proportional characteristics.
  - 5. Internal Tubing: Copper tubing with brazed joints.
  - 6. Internal Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  - 7. Field Piping Connections: Manufacturer's standard.
  - 8. Factory Charge: Dehydrated air or nitrogen.
  - 9. Testing: Factory pressure tested and verified to be without leaks.
- D. Drain Assembly:
  - 1. Pan: Non-ferrous material, with bottom sloped to low point drain connection.
  - 2. Condensate Removal: Unit-mounted pump or other integral lifting mechanism, capable of lifting drain water to an elevation above top of cabinet.
  - 3. Field Piping Connection: Non-ferrous material with threaded NPT.
- E. Fan and Motor Assembly:
  - 1. Fan(s):
    - a. Direct-drive arrangement.
    - b. Single or multiple fans connected to a common motor shaft and driven by a single motor.
    - c. Fabricated from non-ferrous components or ferrous components with corrosion protection finish.
    - d. Wheels statically and dynamically balanced.
  - 2. Motor: Brushless dc or electronically commutated with permanently lubricated bearings.
  - 3. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  - 4. Speed Settings and Control: Two (low, high), three (low, medium, high), or more than three speed settings or variable speed with a speed range of least 50 percent.
  - 5. Vibration Control: Integral isolation to dampen vibration transmission.



- F. Filter Assembly:
  - 1. Access: Bottom, to accommodate filter replacement without the need for tools.
  - 2. Media:
    - a. Washable: Manufacturer's standard filter with antimicrobial treatment.
- G. Discharge-Air Grille Assembly: Mounted in bottom of unit cabinet.
  - 1. Discharge Pattern: One-, two-, three-, or four-way throw as indicated on Drawings.
    - a. Discharge Pattern Adjustment: Field-adjustable limits for up and down range of motion.
    - b. Discharge Pattern Closure: Ability to close individual discharges of units with multiple patterns.
  - 2. Motorized Vanes: Modulating up and down flow pattern for uniform room air distribution.
- H. Return-Air Grille Assembly: Manufacturer's standard grille mounted in bottom of unit cabinet.

## 2.6 OUTDOOR, AIR-SOURCE HEAT RECOVERY UNITS & HEAT PUMP VRF UNITS

- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
  - 1. Specially designed for use in systems with simultaneous heating and cooling or heat pump changeover as indicated on plans.
  - 2. Systems shall consist of one unit, or multiple unit modules that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
  - 3. All units installed shall be from the same product development generation.
- B. Cabinet:
  - 1. Galvanized steel and coated with a corrosion-resistant finish.
    - a. Coating with documented salt spray test performance of 1000 hours according ASTM B117 surface scratch test (SST) procedure.
  - 2. Mounting: Manufacturer-designed provisions for field installation.
  - 3. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Compressor and Motor Assembly:
  - 1. One or more positive-displacement, direct-drive and hermetically sealed scroll compressor(s) with inverter drive and turndown to 15 percent of rated capacity.
  - 2. Protection: Integral protection against the following:
    - a. High refrigerant pressure.
    - b. Low oil level.
    - c. High oil temperature.
    - d. Thermal and overload.
    - e. Voltage fluctuations.
    - f. Phase failure and phase reversal.
    - g. Short cycling.





3. Speed Control: Variable to automatically maintain refrigerant suction and condensing pressures while varying refrigerant flow to satisfy system cooling and heating loads.
  4. Vibration Control: Integral isolation to dampen vibration transmission.
  5. Oil management system to ensure safe and proper lubrication over entire operating range.
  6. Crankcase heaters with integral control to maintain safe operating temperature.
  7. Fusible plug.
- D. Condenser Coil Assembly:
1. Plate Fin Coils:
    - a. Casing: Aluminum, galvanized, or stainless steel.
    - b. Fins: Aluminum or copper, mechanically bonded to tubes, with arrangement required by performance.
    - c. Tubes: Copper, of diameter and thickness required by performance.
  2. Aluminum Microchannel Coils:
    - a. Series of flat tubes containing a series of multiple, parallel-flow microchannels layered between refrigerant header manifolds.
    - b. Single- or multiple-pass arrangement.
    - c. Construct fins, tubes, and header manifolds of aluminum alloy.
  3. Coating: Corrosion resistant.
  4. Hail Protection: Provide condenser coils with louvers, baffles, or hoods to protect against hail damage.
- E. Condenser Fan and Motor Assembly:
1. Fan(s): Propeller type.
    - a. Direct-drive arrangement.
    - b. Fabricated from non-ferrous components or ferrous components with corrosion protection finish to match performance indicated for condenser coil.
    - c. Statically and dynamically balanced.
  2. Fan Guards: Removable safety guards complying with OSHA regulations. If using metal materials, coat with corrosion-resistant coating to match performance indicated for condenser coil.
  3. Motor(s): Brushless dc or electronically commutated with permanently lubricated bearings and rated for outdoor duty.
  4. Motor Protection: Integral protection against thermal, overload, and voltage fluctuations.
  5. Speed Settings and Control: Variable speed with a speed range of least 75 percent.
  6. Vibration Control: Integral isolation to dampen vibration transmission.
- F. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- G. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for unprotected outdoor locations.
  2. Factory-Installed Controller: Configurable digital control.



3. Factory-Installed Sensors:
    - a. Refrigerant suction temperature.
    - b. Refrigerant discharge temperature.
    - c. Outdoor air temperature.
    - d. Refrigerant high pressure.
    - e. Refrigerant low pressure.
    - f. Oil level.
  4. Features and Functions: Self-diagnostics, time delay, auto-restart, fuse protection, auto operation mode, manual operation mode, night setback control, power consumption display, run test switch equalize run time between multiple same components.
  5. Communication: Network communication with indoor units and other outdoor unit(s). Provide manufacturer's "Central Controller."
  6. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  7. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- H. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for unprotected outdoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.
  5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.
- I. Unit Hardware: Zinc-plated steel, or stainless steel. Coat exposed surfaces with additional corrosion-resistant coating if required to prevent corrosion when exposed to salt spray test for 1000 hours according ASTM B117.
- J. Unit Piping:
1. Unit Tubing: Copper tubing with brazed joints.
  2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
  3. Field Piping Connections: Manufacturer's standard.
  4. Factory Charge: Dehydrated air or nitrogen.
  5. Testing: Factory pressure tested and verified to be without leaks.
- 2.7 HEAT RECOVERY CONTROL UNITS (HRCUs)
- A. Description: Factory-assembled and -tested complete unit with components, piping, wiring, and controls required for mating to piping, power, and controls field connections.
1. Specially designed for use in systems with simultaneous heating and cooling.



2. Systems shall consist of one unit, or multiple unit that are designed by variable refrigerant system manufacturer for field interconnection to make a single refrigeration circuit that connects multiple indoor units.
- B. Cabinet:
1. Galvanized-steel construction.
  2. Insulation: Manufacturer's standard internal insulation to provide thermal resistance and prevent condensation.
  3. Mounting: Manufacturer-designed provisions for field installation.
  4. Internal Access: Removable panels or hinged doors of adequate size for field access to internal components for inspection, cleaning, service, and replacement.
- C. Drain Pan: If required by manufacturer's design, provide unit with non-ferrous drain pan with bottom sloped to a low point drain connection.
- D. Refrigeration Assemblies and Specialties:
1. Specially designed by manufacturer for type of VRF HVAC system being installed, either two or three pipe.
  2. Each refrigerant branch circuit shall have refrigerant control valve(s) to control refrigerant flow.
  3. Spares: Each heat recovery control unit shall include at least one branch circuit port(s) for future use.
  4. Each system piping connection upstream of heat recovery unit shall be fitted with an isolation valve to allow for service to any heat recovery control unit in the system without interrupting operation of the system.
  5. Each branch circuit connection shall be fitted with an isolation valve and capped service port to allow for service to any individual branch circuit without interrupting operation of the system.
    - a. If not available as an integral part of the heat recovery control unit, isolation valves shall be field installed adjacent to the unit pipe connection.
- E. Unit Controls:
1. Enclosure: Manufacturer's standard, and suitable for indoor locations.
  2. Factory-Installed Controller: Configurable digital control.
  3. Features and Functions: Self-diagnostics, fuse protection.
  4. Communication: Network communication with indoor units and outdoor unit(s).
  5. Cable and Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
  6. Field Connection: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
- F. Unit Electrical:
1. Enclosure: Metal, similar to enclosure, and suitable for indoor locations.
  2. Field Connection: Single point connection to power entire unit and integral controls.
  3. Disconnecting Means: Factory-mounted circuit breaker or switch, complying with NFPA 70.
  4. Control Transformer: Manufacturer's standard. Coordinate requirements with field power supply.



5. Wiring: Manufacturer's standard with each connection labeled and corresponding to a unit-mounted wiring diagram.
6. Raceways: Enclose line voltage wiring in metal raceways to comply with NFPA 70.

G. Unit Piping:

1. Unit Tubing: Copper tubing with brazed joints.
2. Unit Tubing Insulation: Manufacturer's standard insulation, of thickness to prevent condensation.
3. Field Piping Connections: Manufacturer's standard.
4. Factory Charge: Dehydrated air or nitrogen.
5. Testing: Factory pressure tested and verified to be without leaks.

## 2.8 SYSTEM CONTROL CABLE

A. Cable Rating: Listed and labeled for application according to NFPA 70.

1. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
  - a. Flame Travel Distance: 60 inches or less.
  - b. Peak Optical Smoke Density: 0.5 or less.
  - c. Average Optical Smoke Density: 0.15 or less.
2. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
3. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.

B. Low-Voltage Control Cabling:

1. Paired Cable: NFPA 70, Type CMG.
  - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
  - b. PVC insulation.
  - c. Braided or foil shielded.
  - d. PVC jacket.
  - e. Flame Resistance: Comply with UL 1685.
2. Plenum-Rated, Paired Cable: NFPA 70, Type CMP.
  - a. One pair, twisted, No. 16 AWG, stranded (19x29) or No. 18 AWG, stranded (19x30) tinned-copper conductors as required by VRF HVAC system manufacturer.
  - b. PVC insulation.
  - c. Braided or foil shielded.
  - d. PVC jacket.
  - e. NFPA 262 includes the standard flame-resistance test criteria in common use for cables and conductors.
  - f. Flame Resistance: Comply with NFPA 262.



## 2.9 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect factory-assembled equipment.
- B. Equipment will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports for historical record. Submit reports only if requested.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine products before installation. Reject products that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for piping and tubing to verify actual locations of connections before equipment installation.
- D. Examine roughing-in for ductwork to verify actual locations of connections before equipment installation.
- E. Examine roughing-in for wiring and conduit to verify actual locations of connections before equipment installation.
- F. Examine walls, floors, roofs, and outdoor pads for suitable conditions where equipment will be installed.
- G. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- H. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 EQUIPMENT INSTALLATION, GENERAL

- A. Clearance:
  - 1. Maintain manufacturer's recommended clearances for service and maintenance.
  - 2. Maintain clearances required by governing code.
- B. Loose Components: Install components, devices, and accessories furnished by manufacturer, with equipment, that are not factory mounted.
  - 1. Loose components shall be installed by manufacturer's service representative or system Installer under supervision of manufacturer's service representative.
- C. Equipment Restraint Installation: Install equipment with seismic-restraint device. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

### 3.3 INSTALLATION OF INDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Unless otherwise required by VRF HVAC system manufacturer, support ceiling-mounted units from structure above using threaded rods; minimum rod size of 3/8 inch.
- C. Adjust supports of exposed and recessed units to draw units tight to adjoining surfaces.



- D. Protect finished surfaces of ceilings, floors, and walls that come in direct contact with units. Refinish or replaced damaged areas after units are installed.
- E. In rooms with ceilings, conceal piping and tubing, controls, and electrical power serving units above ceilings.
- F. In rooms without ceiling, arrange piping and tubing, controls, and electrical power serving units to provide a neat and finished appearance.
- G. Provide lateral bracing if needed to limit movement of suspended units to not more than 0.25 inch.
- H. For floor- and wall-mounted units that are exposed, conceal piping and tubing, controls, and electrical power serving units within walls.
- I. Floor-mounted units located in mechanical rooms.
- J. Install floor-mounted units on support structure indicated on Drawings.
- K. Install floor-mounted units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
- L. Attachment: Install hardware for proper attachment to supported equipment.
- M. Grouting: Place grout under equipment supports and make bearing surface smooth.

### 3.4 INSTALLATION OF OUTDOOR UNITS

- A. Install units to be level and plumb while providing a neat and finished appearance.
- B. Install outdoor units on support structures indicated on Drawings, if no support structures are indicated on drawings provide manufacturer's 24" tall unit stands.
- C. Pad-Mounted Installations: Install outdoor units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 03 30 00 "Cast-in-Place Concrete."
  - 1. Attachment: Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 2. Grouting: Place grout under equipment supports and make bearing surface smooth.
  - 3. Concrete pad shall be sized to accept manufacturer's equipment stand.
- D. Roof-Mounted Installations: Install outdoor units on equipment supports specified in Section 07 72 00 "Roof Accessories." Anchor units to supports with removable, stainless-steel fasteners.

### 3.5 GENERAL REQUIREMENTS FOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping and tubing systems. Install piping and tubing as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping and tubing in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping and tubing at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.



- D. Install piping and tubing above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping and tubing to permit valve servicing.
- F. Install piping and tubing at indicated slopes.
- G. Install piping and tubing free of sags.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping and tubing to allow application of insulation.
- J. Install groups of pipes and tubing parallel to each other, spaced to permit applying insulation with service access between insulated piping and tubing.
- K. Exposes piping and tubing interior and exterior shall at a minimum be enclosed within “slim-duct” color to be determined.

### 3.6 INSTALLATION OF SYSTEM CONDENSATE DRAIN PIPING

- A. General Requirements for Drain Piping and Tubing:
  - 1. Install a union in piping at each threaded unit connection.
  - 2. Install an adjustable stainless-steel hose clamp with adjustable gear operator on unit hose connections. Tighten clamp to provide a leak-free installation.
  - 3. If required for unit installation, provide a trap assembly in drain piping to prevent air circulated through unit from passing through drain piping. Comply with more stringent of the following:
    - a. Details indicated on Drawings.
    - b. Manufacturer's requirements.
    - c. Governing codes.
    - d. In the absence of requirements, comply with requirements of ASHRAE handbooks.
  - 4. Extend drain piping from units with drain connections to drain receptors as indicated on Drawings. If not indicated on Drawings, terminate drain connection at nearest accessible location that is not exposed to view by occupants.
  - 5. Provide each 90-degree change in direction with a Y- or T-fitting. Install a threaded plug connection in the dormant side of fitting or future use as a service cleanout.
- B. Gravity Drains:
  - 1. Slope piping from unit connection toward drain termination at a constant slope of not less than one percent.
- C. Pumped Drains:
  - 1. If unit condensate pump or lift mechanism is not included with an integral check valve, install a full-size check valve in each branch pipe near unit connection to prevent backflow into unit.

### 3.7 ELECTRICAL INSTALLATION

- A. Comply with requirements indicated on Drawings and in applicable Division 26 Sections.



- B. To extent electrical power is required for system equipment, components, and controls, and is not indicated on Drawings and addressed in the Specifications, the design for such electrical power shall be delegated to VRF HVAC system provider.
    - 1. Delegated design of electrical power to equipment, components and controls, and associated installation shall be included at no additional cost to Owner.
  - C. Connect field electrical power source to each separate electrical device requiring field electrical power. Coordinate termination point and connection type with Installer.
  - D. Comply with requirements in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.
  - E. Comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems" for grounding connections.
  - F. Install nameplate or acrylic label with self-adhesive back for each electrical connection indicating electrical equipment designation and circuit number feeding connection.
    - 1. Nameplate shall be laminated phenolic layers of black with engraved white letters. Letters at least 1/2 inch high.
    - 2. Locate nameplate or label where easily visible.
  - G. Comply with requirements in Section 26 05 33 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or revised in this Section.
    - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
    - 2. Outlet boxes for cables shall be no smaller than 4 inches square by 1-1/2 inches deep with extension ring sized to bring edge of ring to within 1/8 inch of the finished wall surface.
    - 3. Flexible metal conduit shall not be used.
  - H. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
  - I. Install manufactured conduit sweeps and long-radius elbows if possible.
  - J. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- 3.8 INSTALLATION OF SYSTEM CONTROL CABLE
- A. Comply with NECA 1.
  - B. Installation Method:
    - 1. Install cables in raceways except as follows:
      - a. Within equipment and associated control enclosures.
      - b. In accessible ceiling spaces where open cable installation method may be used.
      - c. In gypsum board partitions where cable may be enclosed within wall cavity.
    - 2. Conceal raceway and cables except in unfinished spaces.
  - C. General Requirements for Cabling:
    - 1. Comply with TIA-568-C Series of standards.
    - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."





3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable.
5. Cables serving a common system may be grouped in a common raceway. Install control cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles or access panels.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals.
15. Do not bend cables in a radius less than 10 times the cable OD.
16. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
17. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

D. Balanced Twisted-Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted-pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

E. Open-Cable Installation:

1. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
2. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Separation from EMI Sources: Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded cable from potential EMI sources including electrical power wiring and equipment.

### 3.9 FIRESTOPPING

- A. Comply with requirements in Section 07 84 13 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."



- C. Comply with BICSI TDMM, "Firestopping" Chapter.

### 3.10 GROUNDING INSTALLATION

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control cabling, comply with requirements in Section 26 05 26 "Grounding and Bonding for Electrical Systems."

### 3.11 IDENTIFICATION

- A. Identify system equipment, piping, tubing, and valves. Comply with requirements for identification specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."
- B. Identify system electrical and controls components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify each control cable on each end and at each terminal with a number-coded identification tag. Each cable shall have a unique tag.

### 3.12 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage VRF HVAC system manufacturer's service representative to advise and assist installers; witness testing; and observe and inspect components, assemblies, and equipment installations, including controls and connections.
  - 1. Field service shall be performed by a factory-trained and -authorized service representative of VRF HVAC system manufacturer whose primary job responsibilities are to provide direct technical support of its products.
    - a. Additional factory-authorized representatives may assist with completion of certain activities only if supervised by manufacturer's employee. A factory-authorized representative shall not provide assistance without manufacturer's employee supervision.
  - 2. Final Inspection before Startup:
    - a. Before inspection, Installer to provide written request to manufacturer stating the system is fully installed according manufacturer's requirements and ready for final inspection.
    - b. All system equipment and operating components shall be inspected. If components are inaccessible for inspection, they shall be made accessible before the final inspection can be completed.
    - c. Manufacturer shall provide a comprehensive inspection of all equipment and each operating component that comprise the complete system(s). Inspection shall follow a detailed checklist specific to each equipment and operating component.
- B. Perform the following tests and inspections with the assistance of manufacturer's service representative:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.



4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Refrigerant Tubing Positive Pressure Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
  2. After completion of tubing installation, pressurize tubing systems to a test pressure of not less than 1.2 times VRF HVAC system operating pressure, but not less than 600 psig, using dry nitrogen.
  3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of 24 hours. Allowance for pressure changes attributed to changes in ambient temperature are acceptable.
  4. Prepare test report to record the following information for each test:
    - a. Name of person starting test, company name, phone number, and e-mail address.
    - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    - c. Detailed description of extent of tubing tested.
    - d. Date and time at start of test.
    - e. Test pressure at start of test.
    - f. Outdoor temperature at start of test.
    - g. Name of person ending test, company name, phone number, and e-mail address.
    - h. Date and time at end of test.
    - i. Test pressure at end of test.
    - j. Outdoor temperature at end of test.
    - k. Remarks:
  5. Submit test reports for Project record.
- D. Refrigerant Tubing Evacuation Testing:
1. Comply with more stringent of VRF HVAC system manufacturer's requirements and requirements indicated.
  2. After completion of tubing positive-pressure testing, evacuate tubing systems to a pressure of 500 microns.
  3. Successful testing shall maintain a test pressure for a continuous and uninterrupted period of one hour with no change.
  4. Prepare test report to record the following information for each test:
    - a. Name of person starting test, company name, phone number, and e-mail address.
    - b. Name of manufacturer's service representative witnessing test, company name, phone number, and e-mail address.
    - c. Detailed description of extent of tubing tested.
    - d. Date and time at start of test.
    - e. Test pressure at start of test.
    - f. Outdoor temperature at start of test.
    - g. Name of person ending test, company name, phone number, and e-mail address.
    - h. Date and time at end of test.
    - i. Test pressure at end of test.



- j. Outdoor temperature at end of test.
    - k. Remarks:
  - 5. Submit test reports for Project record.
  - 6. Upon successful completion of evacuation testing, system shall be charged with refrigerant.
  - E. System Refrigerant Charge:
    - 1. Using information collected from the refrigerant tubing evacuation testing, system Installer shall consult variable refrigerant system manufacturer to determine the correct system refrigerant charge.
    - 2. Installer shall charge system following VRF HVAC system manufacturer's written instructions.
    - 3. System refrigerant charging shall be witnessed by system manufacturer's representative.
    - 4. Total refrigerant charge shall be recorded and permanently displayed at the system's outdoor unit.
  - F. Products will be considered defective if they do not pass tests and inspections.
  - G. Prepare test and inspection reports.
- 3.13 STARTUP SERVICE
- A. Engage a VRF HVAC system manufacturer's service representative to perform system(s) startup service.
    - 1. Service representative shall be a factory-trained, authorized service representative of VRF HVAC system manufacturer.
    - 2. Complete startup service of each separate system.
    - 3. Complete system startup service according to manufacturer's written instructions.
  - B. Startup checks shall include, but not be limited to, the following:
    - 1. Check control communications of equipment and each operating component in system(s).
    - 2. Check each indoor unit's response to demand for cooling and heating.
    - 3. Check each indoor unit's response to changes in airflow settings.
    - 4. Check each indoor unit and outdoor unit for proper condensate removal.
    - 5. Check sound levels of each indoor and outdoor unit.
  - C. Installer shall accompany manufacturer's service representative during startup service and provide manufacturer's service representative with requested documentation and technical support during startup service.
    - 1. Installer shall correct deficiencies found during startup service for reverification.
  - D. System Operation Report:
    - 1. After completion of startup service, manufacturer shall issue a report for each separate system.
    - 2. Report shall include complete documentation describing each startup check, the result, and any corrective action required.
  - E. Witness:
    - 1. Invite Architect, Engineer, and Owner to witness startup service procedures.
    - 2. Provide written notice not less than 20 business days before start of startup service.



### 3.14 ADJUSTING

- A. Adjust equipment and components to function smoothly, and lubricate as recommended by manufacturer.
- B. Adjust initial temperature and humidity set points. Adjust initial airflow settings and discharge airflow patterns.
- C. Set field-adjustable switches and circuit-breaker trip ranges according to VRF HVAC system manufacturer's written instructions, and as indicated.
- D. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.15 PROTECTION

- A. Protect products from moisture and water damage. Remove and replace products that are wet, moisture damaged, or mold damaged.
- B. Protect equipment from physical damage. Replace equipment with physical damage that cannot be repaired to new condition. Observable surface imperfections shall be grounds for removal and replacement.
- C. Protect equipment from electrical damage. Replace equipment suffering electrical damage.
- D. Cover and seal openings of equipment to keep inside of equipment clean. Do not remove covers until finish work is complete.

### 3.16 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by manufacturer's authorized service representative. Include two service visits for preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper equipment and system operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

### 3.17 DEMONSTRATION

- A. Engage a VRF HVAC system manufacturer's factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain entire system.
- B. Instructor:
  - 1. Instructor shall be factory trained and certified by VRF HVAC system manufacturer with current training on the system(s), equipment, and controls that are installed.
  - 2. Instructor's credentials shall be submitted for review by Engineer or Owner before scheduling training.
  - 3. Instructor(s) sole job responsibility shall be Owner training.
  - 4. Instructor(s) shall have not less than three years of training experience with VRF HVAC system manufacturer and past training experience on at least three projects of comparable size and complexity.



- C. Schedule and Duration:
  - 1. Schedule training with Owner at least 20 business days before first training session.
  - 2. Training shall occur before Owner occupancy.
  - 3. Training shall be held at mutually agreed date and time during normal business hours.
  - 4. Each training day shall not exceed eight hours of training. Daily training schedule shall allow time for one-hour lunch period and 15-minute break after every two hours of training.
  - 5. Perform not less than eight total hours of training.
- D. Location: Owner shall provide a suitable on-site location to host classroom training.
- E. Training Attendees: Assume three people.
- F. Training Attendance: For record purposes, document training attendees at the start of each new training session. Record attendee's name, signature, phone number, and e-mail address.
- G. Training Format: Individual training modules shall include classroom training followed by hands-on field demonstration and training.
- H. Training Materials: Provide training materials in electronic format to each attendee.
  - 1. Include instructional videos showing general operation and maintenance that are coordinated with operation and maintenance manuals.
  - 2. Video record each classroom training session and submit an electronic copy to Owner before requesting Owner acceptance of training.
- I. Acceptance: Obtain Architect or Owner written acceptance that training is complete and requirements indicated have been satisfied.

END OF SECTION



## SECTION 23 81 43

### AIR-SOURCE UNITARY HEAT PUMPS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This Section specifies electrically operated air-source unitary heat pumps.
- B. A complete listing of common acronyms and abbreviations are included in Section 23 05 11, COMMON WORK RESULTS FOR HVAC.
- C. Definitions:
  - 1. Coefficient of Performance (COP) - Cooling: The ratio of the rate of heat removed to the rate of energy input in consistent units, for a complete refrigerating system or some specific portion of that system under designated operating conditions.
  - 2. Coefficient of Performance (COP) - Heating: The ratio of the rate of heat delivered to the rate of energy input is consistent units for a complete heat pump system, including the compressor and, if applicable, auxiliary heat under designated operating conditions.
  - 3. Energy Efficiency Ratio (EER): The ratio of net cooling capacity is Btu/h to total rate of electricity input in watts under designated operating conditions.
  - 4. Heating Seasonal Performance Factor (HSPF) - Total heating output of heat pump during its normal annual usage period for heating in Btu/h divided by total electric energy input in watts during the same period.
  - 5. Seasonal Energy Efficiency Ratio (SEER) - Total cooling output of an air conditioner during its normal annual usage period for cooling in Btu/h divided by total electric energy input in watts during the same period.
  - 6. Air-Source Unitary Heat Pump: One or more factory made assemblies that normally include an indoor conditioning coil, compressor(s) and an outdoor refrigerant-to-air coil. These units provide both heating and cooling functions.

##### 1.2 RELATED WORK

- A. Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- B. Section 23 23 00, REFRIGERANT PIPING
- C. Section 23 31 00, HVAC DUCTS AND CASINGS

##### 1.3 QUALITY ASSURANCE

- A. Refer to specification Section 23 05 11, COMMON WORK RESULTS FOR HVAC
- B. Comply with ASHRAE Standard 15, Safety Code for Mechanical Refrigeration.



- C. Comply with ASHRAE Standard 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings for cooling and heating performance requirements when tested in accordance with AHRI 210 240 AHRI 340 360 and UL 1995.
- D. Heating Performance shall conform to ASHRAE requirements when tested in accordance with AHRI 210 240 AHRI 340 360 and UL 1995.

#### 1.4 SUBMITTALS

- A. Manufacturer's Literature and Data Including:
  - 1. Air-Source Unitary Heat pump:
    - a. Packaged units
    - b. Split system
- B. Certification: Submit, simultaneously with shop drawings, a proof of certification that this product has been certified by AHRI.
- C. Performance Rating: Submit catalog selection data showing equipment ratings and compliance with required cooling and heating capacities EER and COP values as applicable.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Air-Conditioning Heating and Refrigeration Institute (AHRI) Standards:
  - DCPP(Web-based).....Directory of Certified Product Performance - Applied  
Directory of Certified Products
  - 210/240-2023 (2020) .....Performance Rating of Unitary Air-Conditioning and Air-  
Source Heat Pump Equipment
  - 270 2015.....Sound Rating of Outdoor Unitary Equipment
  - 310 380 2017.....Standard for Packaged Terminal Air-Conditioners and Heat  
Pumps (CSA-C744-04)
  - 340 360 (I-P 2019).....Commercial and Industrial Unitary Air-Conditioning and  
Heat Pump Equipment
- B. Air Movement and Control Association (AMCA):
  - 210 2016.....Laboratory Methods of Testing Fans for Aerodynamic  
Performance Rating (ANSI)
  - 410 1996.....Recommended Safety Practices for Users and Installers of  
Industrial and Commercial Fans
- C. American National Standards Institute (ANSI):
  - S12.51-2012 (R2020).....Acoustics - Determination of Sound Power Levels of Noise  
Sources Using Sound Pressure - Precision Method for  
Reverberation Rooms (same as ISO 3741:1999)





- D. American Society of Heating, Refrigerating and Air-Conditioning Engineers Inc. (ASHRAE):
  - 15-2019 .....Safety Standard for Refrigeration Systems (ANSI)
  - 62.1-2019 .....Ventilation for Acceptable Indoor Air Quality (ANSI)
  - 90.1-2019 (I-P).....Energy Standard for Buildings except Low-Rise Residential Buildings
  - 2020.....HVAC Systems and Equipment Handbook
- E. American Society of Testing and Materials (ASTM):
- F. National Electrical Manufacturer's Association (NEMA):
  - ICS 1-2005 .....Industrial Controls and Systems: General Requirements
  - MG 1-2016 (R2019) .....Motors and Generators (ANSI)
- G. National Fire Protection Association (NFPA):
  - 90A-2021 .....Standard for the Installation of Air-Conditioning and Ventilating Systems
- H. Underwriters Laboratory (UL):
  - 1995-2015 .....Heating and Cooling Equipment

## 1.6 AS-BUILT DOCUMENTATION

- A. Comply with requirements in Paragraph AS-BUILT DOCUMENTATION of Section 23 05 11, COMMON WORK RESULTS FOR HVAC.

## PART 2 - PRODUCTS

### 2.1 UNITARY HEAT PUMPS, AIR TO AIR

- A. Product: As scheduled on drawings.
- B. Unit Electrical
  - 1. Provide single point unit power connection.
  - 2. Unit control box shall be located within the unit and shall contain controls for compressor, reversing valve and fan motor operation.
  - 3. Safety Controls - High pressure, low temperature, and low-pressure safety switches shall be wired through a latching lockout circuit to hold the conditioner off until it is reset electrically by interrupting the power supply to the conditioner. All safety switches shall be normally closed, opening upon fault detection.
- C. Operating Controls
  - 1. Provide unit with the manufacturer's low voltage electric controls.
    - a. Space Temperature Sensor: The wall mounted sensor shall include occupied and unoccupied setpoint control, pushbutton unoccupied override, space temperature offset and space temperature indication. See plans for exact temperature sensor make and model.



D. Accessories:

1. 24" Tall Unit Stand.
2. Manufacturer's wall mounted controller.
3. Snow/Hail Protection Hood.
4. CN24 Auxiliary Heat Relay Kit.
5. Manufacturer's Central Controller – one unit for all systems at school.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. If in the substantiated evaluation of the COR, the installation fails to meet the requirements of the construction documents with respect to function and maintainability, an installation is unsatisfactory to the COR, the Contractor shall correct the installation at no additional cost or time to the Government.
- B. Install heat pumps according to manufacturers printed instructions.
- C. Install electrical and control devices furnished by the manufacturer but not specified to be factory mounted. All electrical work shall comply with Division 26 Sections.
- D. Piping: Comply with requirements in Section 23 23 00, REFRIGERANT PIPING.

### 3.2 STARTUP AND TESTING

- A. Perform startup checks according to manufacturer's written instructions.
- B. Test controls and demonstrate its compliance with project requirements. Replace damaged or malfunctioning controls and equipment and retest the equipment to the satisfaction of the COR.

### 3.3 DEMONSTRATION AND TRAINING

- A. Instruct Maintenance personnel in operation and maintenance of units.

END OF SECTION



## SECTION 23 82 00

### CONVECTION HEATING AND COOLING UNITS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

A. Hydronic Heaters.

##### 1.2 SUBMITTALS

A. Manufacturer's Literature and Data:

1. Electrical Baseboard.

B. See Section 23 05 11, Common Work Results for HVAC, Article 1.4 Submittals for further requirements.

C. See Section 23 05 11, Common Work Results for HVAC, Article 1.7 Quality Assurance.

##### 1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.

B. American National Standards Institute / Air Conditioning, Heating and Refrigeration Institute (ANSI/AHRI):

440-08 .....Performance Rating of Room Fan Coils National Fire  
Protection Association (NFPA):

90A-09 .....Standard for the Installation of Air Conditioning and  
Ventilating Systems

70-11 .....National Electrical Code

C. Underwriters Laboratories, Inc. (UL):

181-08 .....Standard for Factory-Made Air Ducts and Air Connectors

1995-05 .....Heating and Cooling Equipment

#### PART 2 - PRODUCTS

##### 2.1 ELECTRICAL BASEBOARD

A. As Scheduled on Drawings or equal. Verify color with Architect.

#### PART 3 - EXECUTION

##### 3.1 INSTALLATION

A. Work shall be installed as shown and according to the manufacturer's diagrams and recommendations.

B. Handle and install units in accordance with manufacturer's written instructions.

C. Support units rigidly so they remain stationary at all times. Cross-bracing or other means of stiffening shall be provided as necessary. Method of support shall be such that distortion and malfunction of units cannot occur.

END OF SECTION



## SECTION 26 05 11

### REQUIREMENTS FOR ELECTRICAL INSTALLATIONS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section applies to all sections of Division 26.
- B. Furnish and install electrical systems, materials, equipment, and accessories in accordance with the specifications and drawings. Capacities and ratings of motors, transformers, conductors and cable, panelboards, and other items and arrangements for the specified items are shown on the drawings.
- C. Electrical service entrance equipment and arrangements for temporary and permanent connections to the electric utility company's system shall conform to the electric utility company's requirements and paid for by Electrical Contractor. Coordinate fuses, circuit breakers and relays with the electric utility company's system and obtain electric utility company approval for sizes and settings of these devices.
- D. Conductor ampacities specified or shown on the drawings are based on copper conductors, with the conduit and raceways sized per NEC.

##### 1.2 MINIMUM REQUIREMENTS

- A. The International Building Code (IBC), National Electrical Code (NEC), Underwriters Laboratories, Inc. (UL), and National Fire Protection Association (NFPA) codes and standards are the minimum requirements for materials and installation.
- B. The drawings and specifications shall govern in those instances where requirements are greater than those stated in the above codes and standards.

##### 1.3 TEST STANDARDS

- A. All materials and equipment shall be listed, labeled, or certified by a Nationally Recognized Testing Laboratory (NRTL) to meet Underwriters Laboratories, Inc. (UL), standards where test standards have been established. Materials and equipment which are not covered by UL standards will be accepted, providing those materials and equipment are listed, labeled, certified, or otherwise determined to meet the safety requirements of a NRTL. Materials and equipment which no NRTL accepts, certifies, lists, labels, or determines to be safe, will be considered if inspected or tested in accordance with national industrial standards, such as ANSI, NEMA, and NETA. Evidence of compliance shall include certified test reports and definitive shop drawings.



B. Definitions:

1. Listed: Materials and equipment included in a list published by an organization that is acceptable to the Authority Having Jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production or listed materials and equipment or periodic evaluation of services, and whose listing states that the materials and equipment either meets appropriate designated standards or has been tested and found suitable for a specified purpose.
2. Labeled: Materials and equipment to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the Authority Having Jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled materials and equipment, and by who's labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.
3. Certified: Materials and equipment which:
  - a. Have been tested and found by a NRTL to meet nationally recognized standards or to be safe for use in a specified manner.
  - b. Are periodically inspected by a NRTL.
  - c. Bear a label, tag, or other record of certification.
4. Nationally Recognized Testing Laboratory: Testing laboratory which is recognized and approved by the Secretary of Labor in accordance with OSHA regulations.

#### 1.4 QUALIFICATIONS (PRODUCTS AND SERVICES)

- A. Manufacturer's Qualifications: The manufacturer shall regularly and currently produce, as one of the manufacturer's principal products, the materials and equipment specified for this project, and shall have manufactured the materials and equipment for at least three years.

#### 1.5 APPLICABLE PUBLICATIONS

- A. Applicable publications listed in all Sections of Division 26 are the latest issue, unless otherwise noted.
- B. Products specified in all sections of Division 26 shall comply with the applicable publications listed in each section.

#### 1.6 QUALITY ASSURANCE

- A. Materials and equipment furnished shall be new and of current production by manufacturers regularly engaged in the manufacture of such items, and for which replacement parts shall be available.
- B. When more than one unit of the same class or type of materials and equipment is required, such units shall be the product of a single manufacturer.



- C. Equipment Assemblies and Components:
  - 1. Components of an assembled unit need not be products of the same manufacturer.
  - 2. Manufacturers of equipment assemblies, which include components made by others, shall assume complete responsibility for the final assembled unit.
  - 3. Components shall be compatible with each other and with the total assembly for the intended service.
  - 4. Constituent parts which are similar shall be the product of a single manufacturer.
- D. Factory wiring and terminals shall be identified on the equipment being furnished and on all wiring diagrams.

## 1.7 VARIATIONS FROM CONTRACT REQUIREMENTS

- A. Where the Contractor requests variations from the contract requirements, the connecting work and related components shall include, but not be limited to additions or changes to branch circuits, circuit protective devices, conduits, wire, feeders, controls, panels and installation methods.

## 1.8 MATERIALS AND EQUIPMENT PROTECTION

- A. Materials and equipment shall be protected during shipment and storage against physical damage, vermin, dirt, corrosive substances, fumes, moisture, cold and rain.
  - 1. Store materials and equipment indoors in clean dry space with uniform temperature to prevent condensation.
  - 2. During installation, equipment shall be protected against entry of foreign matter, and be vacuum cleaned both inside and outside before testing and operating. Compressed air shall not be used to clean equipment. Remove loose packing and flammable materials from inside equipment.
  - 3. Damaged equipment shall be repaired or replaced, as determined by the Engineer.

## 1.9 WORK PERFORMANCE

- A. All electrical work shall comply with the requirements of NFPA 70 (NEC), NFPA 70B, and NFPA 70E.
- B. Job site safety and worker safety is the responsibility of the Contractor.
- C. Coordinate location of equipment and conduit with other trades to minimize interference.

## 1.10 EQUIPMENT INSTALLATION AND REQUIREMENTS

- A. Equipment location shall be as close as practical to locations shown on the drawings.
- B. Working clearances shall not be less than specified in the NEC.



C. Inaccessible Equipment:

1. Where the Owner/Engineer determines that the Contractor has installed equipment not readily accessible for operation and maintenance, the equipment shall be removed and reinstalled as directed at no additional cost to the Owner.
2. "Readily accessible" is defined as being capable of being reached quickly for operation, maintenance, or inspections without the use of ladders, or without climbing or crawling under or over obstacles such as, but not limited to, motors, pumps, belt guards, transformers, piping, ductwork, conduit and raceways.

## 1.11 EQUIPMENT IDENTIFICATION

- A. In addition to the requirements of the NEC, install an identification sign which clearly indicates information required for use and maintenance of items such as panelboards, cabinets, fused and non-fused safety switches, separately enclosed circuit breakers, individual breakers, control devices and other significant equipment.

## 1.12 RECORD DRAWINGS/AS-BUILT DRAWINGS

- A. The Electrical Subcontractor shall maintain current at the site a set of his drawings on which he shall accurately show the actual installation of all work provided under his Contract indicating hereon any variation from the Contract Drawings, in accordance with the General Conditions and Division I. Changes, whether resulting from formal change orders or other instructions issued by the Architect, shall be recorded. Include changes in sizes, location, and dimensions of conduit, switch gear, lighting fixtures, fire alarm equipment, wiring devices, etc.
- B. The marked-up prints will be used as a guide for determining the progress of the work installed. They shall be inspected periodically by the Architect and Owner and they shall be corrected immediately if found either inaccurate or incomplete. This procedure is mandatory.
- C. At the completion of the job, these prints shall be submitted to the General Contractor and then to the Architect for final review and comment. The prints will be returned with appropriate comments and recommendations. These corrected prints, together with corrected prints indicating all the revisions, additions, and deletions of work, shall form the basis for preparing a set of As-built Record Drawings.
- D. The Subcontractor shall be responsible for generating as-built Record Drawings utilizing Adobe Acrobat PDF based documents. A bound set of plans, as well as the computer files, on a disk or USB storage drive, shall be turned over to the Architect for review. After acceptance of the as-built documents by the Architect, the Electrical Subcontractor shall make any corrections necessary to the as-built documents and prepare one set of 24" X 36" or USB storage drive for distribution to the Owner via the Architect.



## 1.12 SUBMITTALS

- A. The Engineer's approval shall be obtained for all materials and equipment before delivery to the job site. Delivery, storage or installation of materials and equipment which has not had prior approval will not be permitted.
- B. All submittals shall include adequate descriptive literature, catalog cuts, shop drawings, test reports, certifications, samples, and other data necessary for the Engineer to ascertain that the proposed materials and equipment comply with drawing and specification requirements. Catalog cuts submitted for approval shall be legible and clearly identify specific materials and equipment being submitted.
- C. Submittals for individual systems and equipment assemblies which consist of more than one item or component shall be made for the system or assembly as a whole. Partial submittals will not be considered for approval.
  - 1. Submittals shall be marked to show specification reference including the section and paragraph numbers.
  - 2. Submit each section separately.
- D. The submittals shall include the following:
  - 1. Information that confirms compliance with contract requirements. Include the manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, manuals, pictures, nameplate data, and test reports as required.

## 1.13 SINGULAR NUMBER

- A. Where any device or part of equipment is referred to in these specifications in the singular number (e.g., "the switch"), this reference shall be deemed to apply to as many such devices as are required to complete the installation as shown on the drawings.

## 1.14 WARRANTY

- A. All work performed, and all equipment and material furnished under this Division shall be free from defects and shall remain so for a period of one year from the date of acceptance of the entire installation by the Owner.
- B. All electrical equipment shall be provided with the manufacturer's standard warranty period for equipment and components. Equipment substitutions shall carry the same warranty period as the scheduled equipment.
- C. The contractor shall submit all required documentation to the manufacturer and provide proof to the owner that the equipment is warrantied.

## PART 2 - PRODUCTS (NOT USED)

## PART 3 - EXECUTION (NOT USED)

END OF SECTION





## SECTION 26 05 19

### LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Building wires and cables rated 2000 V and less.
  - 2. Connectors, splices, and terminations rated 2000 V and less.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.
- C. Qualification Data: For manufacturer's authorized service representative.
- D. Field quality-control reports.

##### 1.04 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.
  - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

#### PART 2 - PRODUCTS

##### 2.01 CONDUCTORS AND CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Alpha Wire Company.
  - 2. American Bare Conductor.
  - 3. Belden Inc.
  - 4. Cerro Wire LLC.
  - 5. Encore Wire Corporation.
  - 6. General Cable Technologies Corporation.
  - 7. Service Wire Co.
  - 8. Southwire Company.
- 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. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."



- D. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable used in VFC circuits.
- E. Conductors: Copper, complying with NEMA WC 70/ICEA S-95-658.
  - 1. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 and Type XHHW-2.
- F. Cable: Type MC with ground wire.

## 2.02 CONNECTORS AND SPLICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. 3M Electrical Products.
  - 2. AFC Cable Systems; a part of Atkore International.
  - 3. Gardner Bender.
  - 4. Hubbell Power Systems, Inc.
  - 5. Ideal Industries, Inc.
  - 6. ILSCO.
  - 7. NSi Industries LLC.
  - 8. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 9. Service Wire Co.
  - 10. Thomas & Betts Corporation; A Member of the ABB Group.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.01 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Feeders: Copper for feeders smaller than No. 4 AWG; copper or aluminum for feeders No. 4 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- D. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

### 3.02 CONDUCTOR INSULATION AND MULTI-CONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type XHHW-2, single conductors in raceway.
- B. Exposed Feeders: Type XHHW-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.



- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal-clad cable, Type MC.
- G. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

### 3.03 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 26 05 33 "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 26 05 29 "Hangers and Supports for Electrical Systems."
- G. Any cables required to be exposed in existing spaces shall have their location coordinated with the Engineer of Record prior to installation and rough-in.

### 3.04 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 12 inches of slack.



### 3.05 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 26 05 53 "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.

### 3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.

### 3.07 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
  - 2. Perform each of the following visual and electrical tests:
    - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
    - b. Test bolted connections for high resistance using one of the following:
      - 1) A low-resistance ohmmeter.
      - 2) Calibrated torque wrench.
      - 3) Thermographic survey.
    - c. Inspect compression applied connectors for correct cable match and indentation.
    - d. Inspect for correct identification.
    - e. Inspect cable jacket and condition.
    - f. Insulation-resistance test on each conductor with respect to ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
    - g. Continuity test on each conductor and cable.
    - h. Uniform resistance of parallel conductors.
  - 3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each 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 switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
  - 4. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- B. Cables will be considered defective if they do not pass tests and inspections.



- C. Prepare test and inspection reports to record the following:
1. Procedures used.
  2. Results that comply with requirements.
  3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION



## SECTION 26 05 26

### GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of grounding and bonding equipment, indicated as grounding equipment in this section.
- B. “Grounding electrode system” refers to grounding electrode conductors and all electrodes required or allowed by NEC.
- C. The terms “connect”, and “bond” are used interchangeably in this section and have the same meaning.

##### 1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables: Low-voltage conductors.
- C. Section 26 05 33, Raceway and Boxes for Electrical Systems: Conduit and boxes.
- D. Section 26 24 16, Panelboards: Low-voltage panelboards.

##### 1.3 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, Requirements for Electrical Installations.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
- B. See Section 26 05 11, Requirements for Electrical Installations, Article 1.12 Submittals for further requirements.
- C. See Section 26 05 11, Requirements for Electrical Installations, Article 1.4 quality assurance for further requirements.



## 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American Society for Testing and Materials (ASTM):
  - B1-07.....Standard Specification for Hard-Drawn Copper Wire
  - B3-07.....Standard Specification for Soft or Annealed Copper Wire
  - B8-11.....Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft
- C. Institute of Electrical and Electronics Engineers, Inc. (IEEE):
  - 81-83 .....IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part 1: Normal Measurements
- D. National Fire Protection Association (NFPA):
  - 70-11 .....National Electrical Code (NEC)
  - 70E-12.....National Electrical Safety Code
  - 99-12 .....Health Care Facilities
- E. Underwriters Laboratories, Inc. (UL):
  - 44-10 .....Thermoset-Insulated Wires and Cables
  - 83-08 .....Thermoplastic-Insulated Wires and Cables
  - 467-07 .....Grounding and Bonding Equipment

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING CONDUCTORS

- A. Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be continuous green for all equipment grounding conductors, except that wire sizes No. 4 AWG and larger shall be identified per NEC.
- B. Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.
- C. Conductor sizes shall not be less than shown on the drawings, or not less than required by the NEC, whichever is greater.

### 2.2 GROUND RODS

- A. Copper clad steel 19 mm (0.75 inch) diameter by 3 M (10 feet) long.
- B. Quantity of rods shall be as shown on the drawings and a minimum of two. Provide additional rods as required to obtain the specified ground resistance requirements per NEC.



## 2.3 CONCRETE ENCASED ELECTRODE

- A. Concrete encased electrode shall be No. 4 AWG bare copper wire, installed per NEC.

## 2.4 GROUND CONNECTIONS

- A. Below Grade and Inaccessible Locations: Exothermic-welded type connectors.
- B. Above Grade:
  - 1. Bonding Jumpers: Listed for use with aluminum and copper conductors. For wire sizes No. 8 AWG and larger, use compression-type connectors. For wire sizes smaller than No. 8 AWG, use mechanical type lugs. Connectors or lugs shall use zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.
  - 2. Connection to Building Steel: Exothermic-welded type connectors.
  - 3. Connection to Grounding Bus Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

## 2.5 GROUND TERMINAL BLOCKS

- A. At any equipment mounting location (e.g., backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide mechanical type lugs, with zinc-plated steel bolts, nuts, and washers. Bolts shall be torqued to the values recommended by the manufacturer.

# PART 3 - EXECUTION

## 3.1 GENERAL

- A. Install grounding equipment in accordance with the NEC, as shown on the drawings, and as specified herein.
- B. System Grounding:
  - 1. Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformer.
- C. Equipment Grounding: Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

## 3.2 INACCESSIBLE GROUNDING CONNECTIONS

- A. Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.





### 3.3 SECONDARY VOLTAGE EQUIPMENT AND CIRCUITS

- A. Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
- B. Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):
  - 1. Provide a grounding electrode conductor sized per NEC between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in metallic piping.
- C. Panelboards and other electrical equipment:
  - 1. Connect the equipment grounding conductors to the ground bus.
  - 2. Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

### 3.4 RACEWAY

- A. Conduit Systems:
  - 1. Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
  - 2. Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.
  - 3. Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.
  - 4. Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with an equipment grounding conductor to the equipment ground bus.
- B. Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.
- C. Boxes, Cabinets, Enclosures, and Panelboards:
  - 1. Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
  - 2. Provide lugs in each box and enclosure for equipment grounding conductor termination.
- D. Wireway Systems:
  - 1. Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No. 6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.
  - 2. Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 M (50 feet).



3. Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.
  4. Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 M (49 feet).
- E. Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.
- F. Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.
- G. Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

### 3.5 CORROSION INHIBITORS

- A. When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

### 3.6 CONDUCTIVE PIPING

- A. Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

### 3.7 GROUND RESISTANCE

- A. Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Owner. Final tests shall ensure that this requirement is met.
- B. Grounding system resistance shall comply with the electric utility company ground resistance requirements.

### 3.8 GROUND ROD INSTALLATION

- A. For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 inches) below final grade.
- C. Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure-type ground connectors.
- D. Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.



### 3.9 ACCEPTANCE CHECKS AND TESTS

- A. Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.
- B. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

END OF SECTION



## SECTION 26 05 29

### HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    - a. Hangers.
    - b. Steel slotted support systems.
    - c. Nonmetallic support systems.
    - d. Trapeze hangers.
    - e. Clamps.
    - f. Brackets.
  - 2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.
  - 1. Trapeze hangers. Include product data for components.
  - 2. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
  - 1. Include design calculations and details of trapeze hangers.
  - 2. Include design calculations for seismic restraints.
- D. Coordination Drawings: Reflected ceiling plan(s) 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. Suspended ceiling components.
  - 2. Structural members to which hangers and supports will be attached.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Items penetrating finished ceiling, including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Projectors.



- E. Welding certificates.

## PART 2 - PRODUCTS

### 2.01 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame Rating: Class 1.
  - 2. Self-extinguishing according to ASTM D 635.

### 2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit; a part of Atkore International.
    - b. B-line, an Eaton business.
    - c. ERICO International Corporation.
    - d. Flex-Strut Inc.
    - e. GS Metals Corp.
    - f. G-Strut.
    - g. Haydon Corporation.
    - h. Metal Ties Innovation.
    - i. Thomas & Betts Corporation, A Member of the ABB Group.
    - j. Unistrut; Part of Atkore International.
    - k. Wesanco, Inc.
  - 2. Material: Galvanized steel.
  - 3. Channel Width: 1-5/8 inches.
  - 4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
  - 6. Channel Dimensions: Selected for applicable load criteria.
- B. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.
- 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.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Hilti, Inc.
    - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 3) MKT Fastening, LLC.
    - 4) Simpson Strong-Tie Co., Inc.
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 where used.
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) B-line, an Eaton business.
    - 2) Empire Tool and Manufacturing Co., Inc.
    - 3) Hilti, Inc.
    - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
    - 5) MKT Fastening, LLC.
3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are 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.

## 2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.01 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.
- B. Comply with requirements for raceways and boxes specified in Section 26 05 33.
- C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- D. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with single-bolt conduit clamps or single-bolt conduit clamps using spring friction action for retention in support channel.



- E. 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.

### 3.02 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, EMTs, IMCs, and RMCs may be supported by openings through structure members, according to 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. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

### 3.03 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION



## SECTION 26 05 33

### RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of conduit, fittings, and boxes, to form complete, coordinated, grounded raceway systems. Raceways are required for all wiring unless shown or specified otherwise.
- B. Definitions: The term conduit, as used in this specification, shall mean any or all of the raceway types specified.

##### 1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations: General electrical requirements and items that are common to more than one section of Division 26.
- B. Section 26 05 26, Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- C. Section 31 23 17, Trenching.
- D. Section 31 23 23, Backfill.

##### 1.3 QUALITY ASSURANCE

- A. Refer to Paragraph, Quality Assurance, in Section 26 05 11, Requirements for Electrical Installations.

##### 1.4 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, Requirements for Electrical Installations.
  - 1. Shop Drawings:
    - a. Submit the following data for approval:
      - 1) Raceway types and sizes.
      - 2) Conduit bodies, connectors and fittings.
      - 3) Junction and pull boxes, types and sizes.
- B. See Section 26 05 11, Requirements for Electrical Installations, Article 1.12 Submittals for further requirements.





## 1.5 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. American National Standards Institute (ANSI):  
C80.1-05.....Electrical Rigid Steel Conduit  
C80.3-05.....Steel Electrical Metal Tubing  
C80.6-05.....Electrical Intermediate Metal Conduit
- C. National Fire Protection Association (NFPA):  
70-11 .....National Electrical Code (NEC)
- D. Underwriters Laboratories, Inc. (UL):  
1-05 .....Flexible Metal Conduit  
5-11 .....Surface Metal Raceway and Fittings  
6-07 .....Electrical Rigid Metal Conduit - Steel  
50-95 .....Enclosures for Electrical Equipment  
360-13 .....Liquid-Tight Flexible Steel Conduit  
467-13 .....Grounding and Bonding Equipment  
514A-13 .....Metallic Outlet Boxes  
514B-12.....Conduit, Tubing, and Cable Fittings  
514C-07.....Nonmetallic Outlet Boxes, Flush-Device Boxes and Covers  
651-11 .....Schedule 40 and 80 Rigid PVC Conduit and Fittings  
651A-11 .....Type EB and A Rigid PVC Conduit and HDPE Conduit  
797-07 .....Electrical Metallic Tubing  
1242-06 .....Electrical Intermediate Metal Conduit - Steel
- E. National Electrical Manufacturers Association (NEMA):  
TC-2-13.....Electrical Polyvinyl Chloride (PVC) Tubing and Conduit  
TC-3-13.....PVC Fittings for Use with Rigid PVC Conduit and Tubing  
FB1-12 .....Fittings, Cast Metal Boxes and Conduit Bodies for Conduit, Electrical Metallic Tubing and Cable  
FB2.10-13 .....Selection and Installation Guidelines for Fittings for use with Non-Flexible Conduit or Tubing (Rigid Metal Conduit, Intermediate Metallic Conduit, and Electrical Metallic Tubing)  
FB2.20-12 .....Selection and Installation Guidelines for Fittings for use with Flexible Electrical Conduit and Cable
- F. American Iron and Steel Institute (AISI):  
S100-2007.....North American Specification for the Design of Cold-Formed Steel Structural Members

## PART 2 - PRODUCTS

### 2.1 MATERIAL

- A. Conduit Size: In accordance with the NEC, but not less than 13 mm (0.5-inch) unless otherwise shown. Where permitted by the NEC, 13 mm (0.5-inch) flexible conduit may be used for tap connections to recessed lighting fixtures.



B. Conduit:

1. Size: In accordance with the NEC, but not less than 13 mm (0.5-inch).
2. Rigid Steel Conduit (RMC): Shall conform to UL 6 and ANSI C80.1.
3. Rigid aluminum: Shall conform to UL 6A and ANSI C80.5.
4. Rigid Intermediate Steel Conduit (IMC): Shall conform to UL 1242 and ANSI C80.6.
5. Electrical Metallic Tubing (EMT): Shall conform to UL 797 and ANSI C80.3. Maximum size not to exceed 105 mm (4 inches) and shall be permitted only with cable rated 600 V or less.
6. Flexible Metal Conduit: Shall conform to UL 1.
7. Liquid-tight Flexible Metal Conduit: Shall conform to UL 360.
8. Direct Burial Plastic Conduit: Shall conform to UL 651 and UL 651A, heavy wall PVC or high density polyethylene (PE).
9. Surface Metal Raceway: Shall conform to UL 5.

C. Conduit Fittings:

1. Rigid Steel and Intermediate Metallic Conduit Fittings:
  - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
  - b. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Only steel or malleable iron materials are acceptable. Integral retractable type IMC couplings are also acceptable.
  - c. Locknuts: Bonding type with sharp edges for digging into the metal wall of an enclosure.
  - d. Bushings: Metallic insulating type, consisting of an insulating insert, molded or locked into the metallic body of the fitting. Bushings made entirely of metal or nonmetallic material are not permitted.
  - e. Erickson (Union-Type) and Set Screw Type Couplings: Approved for use in concrete are permitted for use to complete a conduit run where conduit is installed in concrete. Use set screws of case-hardened steel with hex head and cup point to firmly seat in conduit wall for positive ground. Tightening of set screws with pliers is prohibited.
  - f. Sealing Fittings: Threaded cast iron type. Use continuous drain-type sealing fittings to prevent passage of water vapor. In concealed work, install fittings in flush steel boxes with blank cover plates having the same finishes as that of other electrical plates in the room.
2. Rigid Aluminum Conduit Fittings:
  - a. Standard threaded couplings, locknuts, bushings, conduit bodies, and elbows: Malleable iron, steel or aluminum alloy materials; Zinc or cadmium plate iron or steel fittings. Aluminum fittings containing more than 0.4% copper are prohibited.
  - b. Locknuts and Bushings: As specified for rigid steel and IMC conduit.
  - c. Set Screw Fittings: Not permitted for use with aluminum conduit.
3. Electrical Metallic Tubing Fittings:
  - a. Fittings and conduit bodies shall meet the requirements of UL 514B, ANSI C80.3, and NEMA FB1.
  - b. Only steel or malleable iron materials are acceptable.
  - c. Setscrew Couplings and Connectors: Use setscrews of case-hardened steel with hex head and cup point, to firmly seat in wall of conduit for positive grounding.
  - d. Indent-type connectors or couplings are prohibited.
  - e. Die-cast or pressure-cast zinc-alloy fittings or fittings made of "pot metal" are prohibited.



4. Flexible Metal Conduit Fittings:
    - a. Conform to UL 514B. Only steel or malleable iron materials are acceptable.
    - b. Clamp-type, with insulated throat.
  5. Liquid-tight Flexible Metal Conduit Fittings:
    - a. Fittings shall meet the requirements of UL 514B and NEMA FB1.
    - b. Only steel or malleable iron materials are acceptable.
    - c. Fittings must incorporate a threaded grounding cone, a steel or plastic compression ring, and a gland for tightening. Connectors shall have insulated throats.
  6. Direct Burial Plastic Conduit Fittings: Fittings shall meet the requirements of UL 514C and NEMA TC3.
  7. Surface Metal Raceway Fittings: As recommended by the raceway manufacturer. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, conduit entry fittings, accessories, and other fittings as required for complete system.
  8. Expansion and Deflection Couplings:
    - a. Conform to UL 467 and UL 514B.
    - b. Accommodate a 19 mm (0.75-inch) deflection, expansion, or contraction in any direction, and allow 30 degree angular deflections.
    - c. Include internal flexible metal braid, sized to guarantee conduit ground continuity and a low-impedance path for fault currents, in accordance with UL 467 and the NEC tables for equipment grounding conductors.
    - d. Jacket: Flexible, corrosion-resistant, watertight, moisture and heat-resistant molded rubber material with stainless steel jacket clamps.
- D. Conduit Supports:
1. Parts and Hardware: Zinc-coat or provide equivalent corrosion protection.
  2. Individual Conduit Hangers: Designed for the purpose, having a pre-assembled closure bolt and nut, and provisions for receiving a hanger rod.
  3. Multiple Conduit (Trapeze) Hangers: Not less than 38 mm x 38 mm (1.5 x 1.5 inches), 12-gauge steel, cold-formed, lipped channels; with not less than 9 mm (0.375-inch) diameter steel hanger rods.
  4. Solid Masonry and Concrete Anchors: Self-drilling expansion shields, or machine bolt expansion.
- E. Outlet, Junction, and Pull Boxes:
1. UL-50 and UL-514A.
  2. Rustproof cast metal where required by the NEC or shown on drawings.
  3. Sheet Metal Boxes: Galvanized steel, except where shown on drawings.
- F. Metal Wireways: Equip with hinged covers, except as shown on drawings. Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for a complete system.

## PART 3 - EXECUTION

### 3.1 PENETRATIONS

- A. Cutting or Holes:
1. Cut holes in advance where they should be placed in the structural elements, such as ribs or beams. Obtain the approval of the General Contractor and Engineer of Record prior to drilling through structural elements.



2. Cut holes through concrete and masonry in new and existing structures with a diamond core drill or concrete saw. Pneumatic hammers, impact electric, hand, or manual hammer-type drills are not allowed.
- B. Waterproofing: At floor, exterior wall, and roof conduit penetrations, completely seal the gap around conduit to render it watertight.

### 3.2 INSTALLATION, GENERAL

- A. In accordance with UL, NEC, NEMA, as shown on drawings, and as specified herein.
- B. Raceway systems used for Essential Electrical Systems (EES) shall be entirely independent of other raceway systems.
- C. Install conduit as follows:
1. In complete mechanically and electrically continuous runs before pulling in cables or wires.
  2. Unless otherwise indicated on the drawings or specified herein, installation of all conduits shall be concealed within finished walls, floors, and ceilings.
  3. Flattened, dented, or deformed conduit is not permitted. Remove and replace the damaged conduits with new conduits.
  4. Assure conduit installation does not encroach into the ceiling height head room, walkways, or doorways.
  5. Cut conduits square, ream, remove burrs, and draw up tight.
  6. Independently support conduit at 2.4 M (8 feet) on centers with specified materials and as shown on drawings.
  7. Do not use suspended ceilings, suspended ceiling supporting members, lighting fixtures, other conduits, cable tray, boxes, piping, or ducts to support conduits and conduit runs.
  8. Support within 300 mm (12 inches) of changes of direction, and within 300 mm (12 inches) of each enclosure to which connected.
  9. Close ends of empty conduits with plugs or caps at the rough-in stage until wires are pulled in, to prevent entry of debris.
  10. Conduit installations under fume and vent hoods are prohibited.
  11. Secure conduits to cabinets, junction boxes, pull-boxes, and outlet boxes with bonding type locknuts. For rigid steel and IMC conduit installations, provide a locknut on the inside of the enclosure, made up wrench tight. Do not make conduit connections to junction box covers.
  12. Conduit bodies shall only be used for changes in direction, and shall not contain splices.
- D. Conduit Bends:
1. Make bends with standard conduit bending machines.
  2. Conduit hickey may be used for slight offsets and for straightening stubbed out conduits.
  3. Bending of conduits with a pipe tee or vise is prohibited.
- E. Layout and Homeruns:
1. Install conduit with wiring, including homeruns, as shown on drawings.



### 3.3 CONCEALED WORK INSTALLATION

#### A. In Concrete:

1. Conduit: Rigid steel, IMC, or EMT. Do not install EMT in concrete slabs that are in contact with soil, gravel, or vapor barriers.
2. Align and run conduit in direct lines.
3. Installation of conduit in concrete that is less than 75 mm (3 inches) thick is prohibited.
  - a. Conduit outside diameter larger than one-third of the slab thickness is prohibited.
  - b. Space between conduits in slabs: Approximately six conduit diameters apart, and one conduit diameter at conduit crossings.
  - c. Install conduits approximately in the center of the slab so that there will be a minimum of 19 mm (0.75-inch) of concrete around the conduits.
4. Make couplings and connections watertight. Use thread compounds that are UL approved conductive type to ensure low resistance ground continuity through the conduits. Tightening setscrews with pliers is prohibited.

#### B. Above Furred or Suspended Ceilings and in Walls:

1. Conduit for Conductors 600 V and Below: Rigid steel, IMC, rigid aluminum, or EMT. Mixing different types of conduits in the same system is prohibited.
3. Align and run conduit parallel or perpendicular to the building lines.
4. Connect recessed lighting fixtures to conduit runs with maximum 1.8 M (6 feet) of flexible metal conduit extending from a junction box to the fixture.
5. Tightening set screws with pliers is prohibited.
6. For conduits running through metal studs, limit field cut holes to no more than 70% of web depth. Spacing between holes shall be at least 457 mm (18 inches). Cuts or notches in flanges or return lips shall not be permitted.

### 3.4 EXPOSED WORK INSTALLATION

- A. Conduit for Conductors 600 V and Below: Rigid steel, IMC, rigid aluminum, or EMT. Mixing different types of conduits in the system is prohibited.
- B. Align and run conduit parallel or perpendicular to the building lines.
- C. Install horizontal runs close to the ceiling or beams and secure with conduit straps.
- D. Support horizontal or vertical runs at not over 2.4 M (8 feet) intervals.
- E. Surface Metal Raceways: Use only where shown on drawings. Surface metal raceway paths in existing portions of the building shall be confirmed with the Engineer prior to rough-in or installation.

### 3.5 HAZARDOUS LOCATIONS

- A. Use rigid steel conduit only.
- B. Install UL approved sealing fittings that prevent passage of explosive vapors in hazardous areas equipped with explosion-proof lighting fixtures, switches, and receptacles, as required by the NEC.



### 3.6 WET OR DAMP LOCATIONS

- A. Use rigid steel or IMC conduits unless as shown on drawings.
- B. Provide sealing fittings to prevent passage of water vapor where conduits pass from warm to cold locations, i.e., refrigerated spaces, constant-temperature rooms, air-conditioned spaces, building exterior walls, roofs, or similar spaces.
- C. Use rigid steel or IMC conduit within 1.5 M (5 feet) of the exterior and below concrete building slabs in contact with soil, gravel, or vapor barriers, unless as shown on drawings. Conduit shall be half-lapped with 10 mil PVC tape before installation. After installation, completely recoat or retape any damaged areas of coating.

### 3.7 MOTORS AND VIBRATING EQUIPMENT

- A. Use flexible metal conduit for connections to motors and other electrical equipment subject to movement, vibration, misalignment, cramped quarters, or noise transmission.
- B. Use liquid-tight flexible metal conduit for installation in exterior locations, moisture or humidity laden atmosphere, corrosive atmosphere, water or spray wash-down operations, inside airstream of HVAC units, and locations subject to seepage or dripping of oil, grease, or water.
- C. Provide a green equipment grounding conductor with flexible and liquid-tight flexible metal conduit.

### 3.8 EXPANSION JOINTS

- A. Conduits 75 mm (3 inch) and larger that are secured to the building structure on opposite sides of a building expansion joint require expansion and deflection couplings. Install the couplings in accordance with the manufacturer's recommendations.
- B. Provide conduits smaller than 75 mm (3 inch) with junction boxes on both sides of the expansion joint. Connect flexible metal conduits to junction boxes with sufficient slack to produce a 125 mm (5 inch) vertical drop midway between the ends of the flexible metal conduit. Flexible metal conduit shall have a green insulated copper bonding jumper installed. In lieu of this flexible metal conduit, expansion and deflection couplings as specified above are acceptable.

### 3.9 CONDUIT SUPPORTS

- A. Safe working load shall not exceed one-quarter of proof test load of fastening devices.
- B. Use pipe straps or individual conduit hangers for supporting individual conduits.
- C. Support multiple conduit runs with trapeze hangers. Use trapeze hangers that are designed to support a load equal to or greater than the sum of the weights of the conduits, wires, hanger itself, and an additional 90 kg (200 lbs). Attach each conduit with U-bolts or other approved fasteners.



- D. Support conduit independently of junction boxes, pull-boxes, fixtures, suspended ceiling T-bars, angle supports, and similar items.
- E. Fasteners and Supports in Solid Masonry and Concrete:
  - 1. New Construction: Use steel or malleable iron concrete inserts set in place prior to placing the concrete.
- F. Hollow Masonry: Toggle bolts.
- G. Bolts supported only by plaster or gypsum wallboard are not acceptable.
- H. Metal Structures: Use machine screw fasteners or other devices specifically designed and approved for the application.
- I. Attachment by wood plugs, rawl plug, plastic, lead or soft metal anchors, or wood blocking and bolts supported only by plaster is prohibited.
- J. Chain, wire, or perforated strap shall not be used to support or fasten conduit.
- K. Spring steel type supports, or fasteners are prohibited for all uses except horizontal and vertical supports/fasteners within walls.
- L. Vertical Supports: Vertical conduit runs shall have riser clamps and supports in accordance with the NEC and as shown. Provide supports for cable and wire with fittings that include internal wedges and retaining collars.

### 3.10 BOX INSTALLATION

- A. Boxes for Concealed Conduits:
  - 1. Flush-mounted.
  - 2. Provide raised covers for boxes to suit the wall or ceiling, construction, and finish.
- B. In addition to boxes shown, install additional boxes where needed to prevent damage to cables and wires during pulling-in operations or where more than the equivalent of (4)-90-degree bends are necessary.
- C. Locate pullboxes so that covers are accessible and easily removed. Coordinate locations with piping and ductwork where installed above ceilings.
- D. Remove only knockouts as required. Plug unused openings. Use threaded plugs for cast metal boxes and snap-in metal covers for sheet metal boxes.
- E. Outlet boxes mounted back-to-back in the same wall are prohibited. A minimum 600 mm (24 inch) center-to-center lateral spacing shall be maintained between boxes.
- F. Flush-mounted wall or ceiling boxes shall be installed with raised covers so that the front face of raised cover is flush with the wall. Surface-mounted wall or ceiling boxes shall be installed with surface-style flat or raised covers.



- G. Minimum size of outlet boxes for ground fault circuit interrupter (GFCI) receptacles is 100 mm (4 inches) square x 55 mm (2.125 inches) deep, with device covers for the wall material and thickness involved.
- H. On all branch circuit junction box covers, identify the circuits with black marker.

END OF SECTION





## SECTION 26 05 48

### SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Restraint channel bracings.
  - 2. Restraint cables.
  - 3. Seismic-restraint accessories.
  - 4. Mechanical anchor bolts.
  - 5. Adhesive anchor bolts.
- B. Intent
  - 1. It is the intent of the seismic restraint portion of this specification to provide seismic restraints for non-structural building components. Restraint systems are intended to withstand the stipulated seismic accelerations applied through the component's center of gravity.
  - 2. Each and every support attachment to the structure of equipment that meets the requirements of this specification must be positive.
- C. The work in this section includes the following:
  - 1. Vibration isolation for equipment.
  - 2. Seismic restraints for equipment.
  - 3. Certification of seismic restraint designs and installation supervision.
- D. Definitions
  - 1. The term EQUIPMENT will be used throughout this specification, and it includes ALL non-structural components within the facility and/or serving this facility, such as equipment located in outbuildings or outside of the main structure on the ground. Equipment buried underground are excluded but entry of services through the foundation walls are included. Equipment referred to above is a partial list of equipment for reference. (Equipment not listed is still included in this specification)
  - 2. Life safety systems defined
    - a. All systems involved with fire protection.
    - b. All systems involved with and/or connected to emergency power supply.
  - 3. Positive Attachment
    - a. Positive attachment is defined as a support location with a cast-in or wedge type expansion anchor, a double-sided beam clamp loaded perpendicular to a beam or a welded or through bolted connection to the structure.
  - 4. Transverse Bracing
    - a. Restraint(s) applied to limit motion perpendicular or angular to the center-line of the conduit, cable tray or bus duct.



5. Longitudinal Bracing
  - a. Restraint(s) applied to limit motion along the centerline of conduit, cable tray or bus duct.

E. Related Requirements:

1. Section 26 05 29 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

### 1.03 SUBMITTALS

A. Product Data: For each type of product.

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
  - b. Annotate to indicate application of each product submitted and compliance with requirements.

B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.
  - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic- and Wind- Restraint Details:
  - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
  - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
  - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
  - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

C. Submittals

1. Provide catalog cuts or data sheets on specific vibration isolators and restraints to be utilized, detailing compliance with the specification. Reference "TYPE" as per "PRODUCTS" section of this specification.



2. Provide an itemized list of all isolated and non-isolated equipment including detailed schedules showing isolator and seismic restraints proposed for each piece of equipment, referencing material and seismic calculation drawing numbers.

D. Shop Drawings

1. Show base or stand construction; include dimensions, structural member sizes and support point locations.
2. Indicate isolation devices selected with complete dimensional and deflection data.
3. When walls and slabs are used as seismic restraint locations, details of acceptable methods for conduit, cable tray and bus duct must be included.
4. Provide specific details of seismic restraints and anchors; include number, size and locations for each piece of equipment.
5. Coordinated or contract drawings shall be marked-up with the specific locations and types of restraints shown for conduit, cable tray and bus duct. Rod bracing requirements and assigned load at each and every restraint location shall be clearly delineated, "worst case" analyses are not acceptable. Any and all tributary loads shall be considered for proper restraint sizing.
6. For ceiling suspended equipment, design restraints for a minimum installation angle of 30 degrees from vertical. Indicate maximum installation angle allowed for restraint system as well as braced and unbraced rod lengths at 30, 45, 60, 75 and 90 degrees from vertical, to determine when rod bracing is required.

E. Seismic Certification and Analysis

1. Seismic restraint calculations must be provided for all connections of equipment to the structure. All performance of products (such as; strut, cable, anchors, clips, etc.) associated with restraints must be supported with manufacturer's data sheets or certified calculations.
2. For equipment mounted outside of the building both the seismic acceleration and wind loads shall be calculated, the highest load shall be utilized for the design of the attachment of supports.
3. Analyses must indicate calculated dead loads, derived loads and materials utilized for connections to equipment and structure and detail anchoring methods, bolt diameter, embedment and weld length.
4. An in force, Errors and Omissions insurance certificate must accompany submittals. Manufacturer's product liability insurance certificates are NOT acceptable.

F. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints.

G. Qualification Data: For professional engineer and testing agency.

H. Welding certificates.

I. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing



laboratory as defined by OSHA in 29 CFR 1910.7 and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with NFPA 70.

#### 1.05 MANUFACTURER'S RESPONSIBILITY

- A. Manufacturer of vibration and seismic control equipment shall have the following responsibilities:
  - 1. Determine vibration isolation and seismic restraint sizes and locations.
  - 2. Provide vibration isolation and seismic restraints as specified.
  - 3. Provide installation instructions, drawings and field supervision to insure proper installation and performance of systems.

### PART 2 - PRODUCTS

#### 2.01 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
  - 1. Basic Wind Speed: 100 mph.
  - 2. Building Classification Category: IV.
  - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of HVAC component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
  - 1. Site Class, Seismic Use Group, Component Importance Factor as Defined in the IBC: Reference Structural Specifications.

#### 2.02 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. B-line, an Eaton business.
  - 2. Hilti, Inc.
  - 3. Mason Industries, Inc.
  - 4. Unistrut; Part of Atkore International.



- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

## 2.03 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Kinetics Noise Control, Inc.
  - 2. Loos & Co., Inc.
  - 3. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A 603 galvanized or ASTM A 492 stainless-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

## 2.04 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. B-line, an Eaton business.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
  - 4. TOLCO; a brand of NIBCO INC.
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

## 2.05 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. B-line, an Eaton business.
  - 2. Hilti, Inc.
  - 3. Kinetics Noise Control, Inc.
  - 4. Mason Industries, Inc.



- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## 2.06 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hilti, Inc.
  - 2. Kinetics Noise Control, Inc.
  - 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.
- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

### 3.03 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Floor or roof mounted equipment shall be snubbed, anchored, bolted or welded to the structure. Calculations that determine that isolated equipment movement may be less than the operating clearance of snubbers (restraints) do not preclude the need for snubbers. Equipment must be positively attached to the structure.



- B. Suspended equipment such as transformers shall be two or four point independently braced with TYPE II restraints. Install cable braces taught for non-isolated equipment and slack with 1/2" cable deflection for isolated equipment. Rod bracing shall be installed as per approved submittals and shop drawings.
- C. Horizontally suspended conduit, cable trays and bus duct shall use RESTRAINT TYPE II. Maximum spacing of seismic bracing shall be as per TABLE A at the end of this section.
- D. For overhead supported equipment, over stress of the building structure must not occur. Bracing may occur from; flanges of structural beams, upper truss chords in bar joists or cast in place inserts or drilled and shielded inserts in concrete structures.
  - 1. Any individual calculated seismic load placed on the building structure (other than concrete slabs) that is greater than 2,000# must be reviewed by the project Structural Engineer for approval.
- E. Conduit Risers
  - 1. Where conduits pass through cored holes, holes must be packed with resilient material or fire stop as specified in other sections of this specification and/or state and local codes. No additional horizontal seismic bracing is required at these locations.
  - 2. Conduit risers through cored holes require a riser clamp at each floor level on top of the slab attached in a seismically approved manner for vertical restraint.
  - 3. Conduit risers in shafts require structural steel attached in a seismically approved manner at each floor level and a riser clamp at each floor level on top of, and fastened to the structural steel. The riser clamp and structural steel must be capable of withstanding all static and seismic loads.
- F. Fixtures such as panel lights shall be attached to lay-in ceilings with a minimum of four Teks screws or other means of positive attachment to the T- bar ceiling structure.
- G. Where base anchoring of equipment is insufficient to resist seismic forces, restraint TYPE II shall be located above the unit's center of gravity to suitably resist "g" forces specified.
- H. Non-isolated floor mounted equipment shall use RESTRAINT TYPE I or III.
- I. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork.
- J. Equipment and Hanger Restraints:
  - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
  - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- K. Install cables so they do not bend across edges of adjacent equipment or building structure.



- L. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- M. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- N. Drilled-in Anchors:
  - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
  - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
  - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
  - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
  - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
  - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

### 3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

### 3.05 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
  - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
  - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
  - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
  - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
  - 5. Test to 90 percent of rated proof load of device.
- B. Seismic controls will be considered defective if they do not pass tests and inspections.





- C. Prepare test and inspection reports.

### 3.06 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

### 3.07 INSPECTION

- A. If in the opinion of the project engineer the seismic restraint installation does not meet with the project requirements, an outside consultant will be retained to inspect, verify and submit corrective measures to be taken. The consultant's fees and all work associated with such a review shall be borne by the contractor.

TABLE A SEISMIC BRACING TABLE		
EQUIPMENT	TRANSVERSE	LONGITUDINAL
CONDUIT	40 Feet	80 Feet
BUS DUCT	30 Feet	60 Feet
CABLE TRAY	40 Feet	80 Feet

END OF SECTION



## SECTION 26 05 53

### IDENTIFICATION FOR ELECTRICAL SYSTEMS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. 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, including arc-flash warning labels.
  - 8. Miscellaneous identification products.

##### 1.3 SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style, mounting provisions, and graphic features of identification products.
- C. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.

#### PART 2 - PRODUCTS

##### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME 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.



- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
  - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
  - 1. Provide per legend on the construction drawings.
- B. Warning labels and signs 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."

## 2.3 LABELS

- A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.
- B. Self-Adhesive Labels:
  - 1. Preprinted, 3-mil-thick, polyester flexible label with acrylic pressure-sensitive adhesive.
    - a. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized to fit the cable and/or raceway diameter, such that the clear shield overlaps the entire printed legend.
  - 2. Polyester, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
    - a. Nominal Size: 3.5-by-5-inch.
  - 3. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 4. Marker for Tags: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

## 2.4 TAPES AND STENCILS:

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
- C. Tape and Stencil for Raceways Carrying Circuits 600 V or Less: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.



- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
- E. Underground-Line Warning Tape
  - 1. Tape:
    - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
    - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
    - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
  - 2. Color and Printing:
    - a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.
    - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
    - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".
  - 3. Underground Marking Tape:
    - a. 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.
    - b. Width: 3 inches.
    - c. Overall Thickness: 5 mils.
    - d. Foil Core Thickness: 0.35 mil.
    - e. Weight: 28 lb/1000 sq. ft..
    - f. Tensile according to ASTM D 882: 70 lbf and 4600 psi.
- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

## 2.5 TAGS

- A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.023 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

## 2.6 SIGNS

- A. Baked-Enamel Signs:
  - 1. Preprinted aluminum signs punched or drilled for fasteners, with colors, legend, and size required for application.
  - 2. 1/4-inch grommets in corners for mounting.
  - 3. Nominal Size: 7 by 10 inches.



- B. Laminated Acrylic or Melamine Plastic Signs:
  - 1. Engraved legend.
  - 2. Thickness:
    - a. For signs up to 20 sq. inches, minimum 1/16-inch-.
    - b. For signs larger than 20 sq. inches, 1/8 inch thick.
    - c. Engraved legend with black letters on white face.
    - d. Punched or drilled for mechanical fasteners.
    - e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

## 2.7 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Ideal Industries, Inc.
  - 2. Marking Services, Inc.
  - 3. Panduit Corporation.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
  - 3. Temperature Range: Minus 40 to plus 185 deg F.
  - 4. Color: Black.

## 2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.



### 3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- G. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
- I. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.
- J. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- K. 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.
- L. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

### 3.3 IDENTIFICATION SCHEDULE

- A. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Self-adhesive vinyl labels. Install labels at 30-foot maximum intervals.
- B. 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 tape applied in bands. Install labels at 30-foot maximum intervals.



- 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 240/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Neutral: White.
    - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- D. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- E. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.
- G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive vinyl labels with the conductor designation.
- H. Conductors To Be Extended in the Future: Attach write-on-tags to conductors and list source.
- I. 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 operation and maintenance manual.
- J. 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 direct-buried cables and cables in raceways.
- K. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.



- L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
  - 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.
- M. Arc Flash Warning Labeling: Self-adhesive thermal transfer vinyl labels.
  - 1. Comply with NFPA 70E and ANSI Z535.4.
- N. 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.
- O. 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 and load shedding.
- P. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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 unless equipment is provided with its own identification.
  - 1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless labels are provided with self-adhesive means of attachment, fasten them 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 in the form of a self-adhesive, engraved, laminated acrylic or melamine label.
    - b. Enclosures and electrical cabinets.
    - c. Access doors and panels for concealed electrical items.
    - d. Receptacles: Label that includes panel and circuit number that feeds the receptacle.
    - e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - f. Substations.





- g. Emergency system boxes and enclosures.
- h. Enclosed switches.
- i. Enclosed circuit breakers.
- j. Enclosed controllers.
- k. Variable-speed controllers.
- l. Push-button stations.
- m. Contactors.
- n. Remote-controlled switches, dimmer modules, and control devices.
- o. Monitoring and control equipment.

END OF SECTION



## SECTION 26 05 73

### OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section includes computer-based, overcurrent protective device short-circuit/coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.

##### 1.03 DEFINITIONS

- A. One-Line Diagram: A diagram which shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- B. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- C. SCCR: Short-circuit current rating.
- D. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

##### 1.04 SUBMITTALS

- A. Product Certificates: For short-circuit study and coordination study analysis software, certifying compliance with IEEE 399, IEEE 1584 and NFPA 70E.
- B. Product Data: For computer software program to be used for studies.
- C. Submit the following after the approval of system protective devices submittals. Submittals may be in digital form.
  - 1. Coordination-study input data, including completed computer program input data sheets.
  - 2. Study and equipment evaluation reports.
  - 3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
  - 4. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
    - a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Engineer for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.
    - b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.



- D. Operation and Maintenance Data: For the overcurrent protective devices to include in emergency, operation, and maintenance manuals.
  - 1. Include the following:
    - a. The following parts from the Protective Device Coordination Study Report:
      - 1) One-line diagram.
      - 2) Protective device coordination study.
      - 3) Time-current coordination curves.
    - b. Power system data.

#### 1.05 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.
- B. Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- C. OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

### PART 2 - PRODUCTS

#### 2.01 COMPUTER SOFTWARE DEVELOPERS

- A. Software Developers: Subject to compliance with requirements, provide software by one of the following:
  - 1. ESA Inc.
  - 2. Power Analytics, Corporation.
  - 3. SKM Systems Analysis, Inc.
  - 4. Easy Power
- B. Comply with IEEE 1584, NFPA 70E, IEEE 242, IEEE 551 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.
  - 1. Optional Features:
    - a. Arcing faults.
    - b. Simultaneous faults.
    - c. Explicit negative sequence.
    - d. Mutual coupling in zero sequence.

#### 2.02 SHORT-CIRCUIT STUDY REPORT CONTENT

- A. Executive summary.



- B. Study descriptions, purpose, basis and scope.
- C. One-line diagram, showing the following:
  - 1. Protective device designations and ampere ratings.
  - 2. Cable size and lengths.
  - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
  - 4. Motor and generator designations and kVA ratings.
  - 5. Switchgear, switchboard, motor-control center and panelboard designations.
- D. Comments and recommendations for system improvements, where needed.
- E. Protective Device Evaluation:
  - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
  - 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
  - 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  - 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  - 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.
- G. Short-Circuit Study Output:
  - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Equivalent impedance.
  - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.
    - d. Calculated asymmetrical fault currents:
      - 1) Based on fault-point X/R ratio.
  - 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
    - a. Voltage.
    - b. Calculated symmetrical fault-current magnitude and angle.
    - c. Fault-point X/R ratio.



- d. No AC Decrement (NACD) ratio.
    - e. Equivalent impedance.
    - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
  - H. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of the computer printout.
- 2.03 PROTECTIVE DEVICE COORDINATION STUDY REPORT CONTENTS
- A. Executive summary.
  - B. Study descriptions, purpose, basis and scope. Include case descriptions, definition of terms and guide for interpretation of the computer printout.
  - C. One-line diagram, showing the following:
    - 1. Protective device designations and ampere ratings.
    - 2. Cable size and lengths.
    - 3. Transformer kilovolt ampere (kVA) and voltage ratings.
    - 4. Motor and generator designations and kVA ratings.
    - 5. Switchgear, switchboard, motor-control center, and panelboard designations.
  - D. Study Input Data: As described in "Power System Data" Article.
  - E. Short-Circuit Study:
    - 1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      - a. Voltage.
      - b. Calculated fault-current magnitude and angle.
      - c. Fault-point X/R ratio.
      - d. Equivalent impedance.
    - 2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      - a. Voltage.
      - b. Calculated symmetrical fault-current magnitude and angle.
      - c. Fault-point X/R ratio.
      - d. Calculated asymmetrical fault currents:
        - 1) Based on fault-point X/R ratio.
    - 3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
      - a. Voltage.
      - b. Calculated symmetrical fault-current magnitude and angle.
      - c. Fault-point X/R ratio.
      - d. No AC Decrement (NACD) ratio.
      - e. Equivalent impedance.
      - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.



- F. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
    - a. Phase and Ground Relays:
      - 1) Device tag.
      - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
      - 3) Recommendations on improved relaying systems, if applicable.
    - b. Circuit Breakers:
      - 1) Adjustable pickups and time delays (long time, short time, ground).
      - 2) Adjustable time-current characteristic.
      - 3) Adjustable instantaneous pickup.
      - 4) Recommendations on improved trip systems, if applicable.
    - c. Fuses: Show current rating, voltage, and class.
- G. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
  2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
  3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
  4. Plot the following listed characteristic curves, as applicable:
    - a. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
    - b. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
    - c. Cables and conductors damage curves.
    - d. Ground-fault protective devices.
    - e. Motor-starting characteristics and motor damage points.
    - f. Generators short-circuit decrement curve and generator damage point.
    - g. The largest feeder circuit breaker in each motor-control center and panelboard.
  5. Provide adequate time margins between device characteristics such that selective operation is achieved.
  6. Comments and recommendations for system improvements.



## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study. Obtain all data necessary for the conduct of the study.
  - 2. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.
  - 3. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  - 4. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support the short-circuit study. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
  - 1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  - 2. Obtain electrical power utility impedance at the Building Main Electrical Panel.
  - 3. Power sources and ties.
  - 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  - 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
  - 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
  - 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  - 8. Motor horsepower and NEMA MG 1 code letter designation.
  - 9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

### 3.02 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.



- C. Base study on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin short-circuit current analysis at the breaker in Main Service providing power to CCMC System, extending down to the system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
  - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
  - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:
  - 1. Electric supply termination point.
  - 2. Incoming switchgear.
  - 3. Low-voltage switchgear.
  - 4. Standby generators and automatic transfer switches.
  - 5. Branch circuit panelboards.
  - 6. Disconnect switches.

### 3.03 PROTECTIVE DEVICE COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. The study shall be based on the device characteristics supplied by device manufacturer.
- D. The extent of the electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the breaker in the Building Main Panel serving CCMC MDP, extending down to the system overcurrent protective devices as follows:
  - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
  - 2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.





- G. Transformer Primary Overcurrent Protective Devices:
    - 1. Device shall not operate in response to the following:
      - a. Inrush current when first energized.
      - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
      - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
      - d. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
  - H. Motor Protection:
    - 1. Select protection for low-voltage motors according to IEEE 242 and NFPA 70.
    - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
  - I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
  - J. Generator Protection: Select protection according to manufacturer's written recommendations and to IEEE 242.
  - K. The calculations shall include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and shall apply to low- and medium-voltage, three-phase ac systems. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.
    - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
  - L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and single line-to-ground fault at each of the following:
    - 1. Electric utility's supply termination point.
    - 2. Switchgear.
    - 3. Low-voltage switchgear.
    - 4. Standby generators and automatic transfer switches.
    - 5. Branch circuit panelboards.
  - M. Protective Device Evaluation:
    - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
    - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
    - 3. Any application of series-rated devices shall be recertified, complying with requirements in NFPA 70.
- 3.04 POWER SYSTEM DATA
- A. Obtain all data necessary for the conduct of the overcurrent protective device study.
    - 1. Verify completeness of data supplied in the one-line diagram on Drawings. Call discrepancies to the attention of Architect.



2. For new equipment, use characteristics submitted under the provisions of action submittals and information submittals for this Project.
  3. For existing equipment, whether or not relocated obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. The qualifications of technicians and engineers shall be qualified as defined by NFPA 70E.
- B. Gather and tabulate the following input data to support coordination study. The list below is a guide. Comply with recommendations in IEEE 241 and IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT Level III certification or NICET Electrical Power Testing Level III certification.
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
  2. Electrical power utility impedance at the service.
  3. Power sources and ties.
  4. Short-circuit current at each system bus, three phase and line-to-ground.
  5. Full-load current of all loads.
  6. Voltage level at each bus.
  7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
  8. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
  9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
  10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
  11. Maximum demands from service meters.
  12. Motor horsepower and NEMA MG 1 code letter designation.
  13. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
  14. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
    - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
    - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
    - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
    - d. Generator thermal-damage curve.
    - e. Ratings, types, and settings of utility company's overcurrent protective devices.
    - f. Special overcurrent protective device settings or types stipulated by utility company.
    - g. Time-current-characteristic curves of devices indicated to be coordinated.



- h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
- i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- j. Panelboards, switchboards, motor-control center ampacity, and SCCR in amperes rms symmetrical.
- k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of the downstream equipment. Obtain device data details to allow verification that series application of these devices complies with NFPA 70 and UL 489 requirements.

### 3.05 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to the recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Electrical Contractor.
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

### 3.06 DEMONSTRATION

- A. Engage the Coordination Study Specialist to train Owner's maintenance personnel in the following:
  - 1. Acquaint personnel in the fundamentals of operating the power system in normal and emergency modes.
  - 2. Hand-out and explain the objectives of the coordination study, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting the time-current coordination curves.
  - 3. Adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION



## SECTION 26 09 23

### LIGHTING CONTROL DEVICES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Time switches.
  - 2. Photoelectric switches.
  - 3. Indoor occupancy and vacancy sensors.
  - 4. Manual switches.
- B. Related Requirements:
  - 1. Section 26 27 26 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings:
  - 1. Show installation details for the following:
    - a. Occupancy sensors.
  - 2. Interconnection diagrams showing field-installed wiring.
  - 3. Include diagrams for power, signal, and control wiring.
- C. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which equipment will be attached.
  - 3. Items penetrating finished ceiling, including the following:
    - a. Luminaires.
    - b. Air outlets and inlets.
    - c. Access panels.
    - d. Control modules.
- D. Field quality-control reports.
- E. Sample Warranty: For manufacturer's warranties.
- F. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.



- G. Software and Firmware Operational Documentation:
  - 1. Software operating and upgrade manuals.
  - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
  - 3. Device address list.
  - 4. Printout of software application and graphic screens.

#### 1.04 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Faulty operation of lighting control software.
    - b. Faulty operation of lighting control devices.
  - 2. Warranty Period: Two year(s) from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.01 TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Industries, Inc.
  - 2. Intermatic, Inc.
  - 3. Invensys Controls.
  - 4. Leviton Manufacturing Co., Inc.
  - 5. NSi Industries LLC.
  - 6. Tyco Electronics Corporation; a TE Connectivity Ltd. company.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
  - 1. Listed and labeled as defined in NFPA 70 and marked for intended location and application.
  - 2. Contact Configuration: DPST.
  - 3. Contact Rating: 20-A driver load, 120-/240-V ac
  - 4. Programs: 56 on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.
  - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
  - 6. Astronomic Time: All channels.
  - 7. Automatic daylight savings time changeover.
  - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

#### 2.02 INDOOR OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bryant Electric.
  - 2. Cooper Industries, Inc.



3. Hubbell Building Automation, Inc.
4. Leviton Manufacturing Co., Inc.
5. Lithonia Lighting; Acuity Brands Lighting, Inc.
6. Lutron Electronics Co., Inc.
7. NSi Industries LLC.
8. Philips Lighting Controls.
9. RAB Lighting.
10. Sensor Switch, Inc.
11. Square D.
12. Watt Stopper.

B. General Requirements for Sensors:

1. Wall or ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated or separate power pack.
4. Hardwired.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
  - a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
8. Power: Line voltage.
9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. 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.
11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. Dual-Technology Type: Wall or 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.
4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet when mounted 48 inches above finished floor.

## 2.03 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 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. 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.
- C. 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.

### 3.03 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

### 3.04 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.



- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

### 3.05 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 26 05 53 "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

### 3.06 FIELD QUALITY CONTROL

- A. Lighting control devices will be considered defective if they do not pass tests and inspections.
- B. Prepare test and inspection reports.

### 3.07 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
  - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
  - 2. For daylighting controls, adjust set points and dead band controls to suit Owner's operations.
  - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

### 3.08 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  - 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

### 3.09 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION





## SECTION 26 24 16

### PANELBOARDS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of panelboards.

##### 1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables: Low-voltage conductors.
- C. Section 26 05 26, Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path for possible ground fault currents.
- D. Section 26 05 33, Raceway and Boxes for Electrical Systems: Conduits.

##### 1.3 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, Requirements for Electrical Installations.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, circuit breakers, wiring and connection diagrams, accessories, and nameplate data.
- B. See Section 26 05 11, Requirements for Electrical Installations, Article 1.12 Submittals for further requirements.
- C. See Section 26 05 11, Requirements for Electrical Installations, Article 1.4 Quality Assurance for further requirements.

##### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):
  - IBC-12.....International Building Code



- C. National Electrical Manufacturers Association (NEMA):
  - PB 1-11 .....Panelboards
  - 250-08 .....Enclosures for Electrical Equipment (1,000V Maximum)
- D. National Fire Protection Association (NFPA):
  - 70-11 .....National Electrical Code (NEC)
  - 70E-12.....Standard for Electrical Safety in the Workplace
- E. Underwriters Laboratories, Inc. (UL):
  - 50-95 .....Enclosures for Electrical Equipment
  - 67-09 .....Panelboards
  - 489-09 .....Molded Case Circuit Breakers and Circuit Breaker Enclosures

## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Panelboards shall be in accordance with NEC, NEMA, UL, as specified, and as shown on the drawings.
- B. Panelboards shall have main breaker or main lugs, bus size, voltage, phases, number of circuit breaker mounting spaces, top or bottom feed, flush or surface mounting, branch circuit breakers, and accessories as shown on the drawings.
- C. Panelboards shall be completely factory-assembled with molded case circuit breakers and integral accessories as shown on the drawings or specified herein.
- D. Non-reduced size copper bus bars, rigidly supported on molded insulators, and fabricated for bolt-on type circuit breakers.
- E. Busbar connections to the branch circuit breakers shall be the “distributed phase” or “phase sequence” type.
- F. Mechanical lugs furnished with panelboards shall be cast, stamped, or machined metal alloys listed for use with the conductors to which they will be connected.
- G. Grounding bus bar shall be equipped with screws or lugs for the connection of equipment grounding conductors.
- H. Busbars shall be braced for the available short-circuit current as shown on the drawings, but not be less than 22,000 A symmetrical for panelboards.

### 2.2 ENCLOSURES AND TRIMS

- A. Enclosures:
  - 1. Provide galvanized steel enclosures, with NEMA rating as shown on the drawings or as required for the environmental conditions in which installed.
  - 2. Enclosures shall not have ventilating openings.



3. Enclosures may be of one-piece formed steel or of formed sheet steel with end and side panels welded, riveted, or bolted as required.
4. Provide manufacturer's standard option for prepunched knockouts on top and bottom endwalls.
5. Include removable inner dead front cover, independent of the panelboard cover.

B. Trims:

1. Hinged "door-in-door" type.
2. Interior hinged door with hand-operated latch or latches, as required to provide access only to circuit breaker operating handles, not to energized parts.
3. Outer hinged door shall be securely mounted to the panelboard enclosure with factory bolts, screws, clips, or other fasteners, requiring a key or tool for entry. Hand-operated latches are not acceptable.
4. Inner and outer doors shall open left to right.
5. Trims shall be flush, or surface type as shown on the drawings.

## 2.3 MOLDED CASE CIRCUIT BREAKERS

A. Circuit breakers shall be per UL, NEC, as shown on the drawings, and as specified.

B. Circuit breakers shall be bolt-on type.

C. Circuit breakers shall have minimum interrupting rating as required to withstand the available fault current, but not less than:

1. 120/240 V Panelboard: 22,000 A symmetrical.
2. Series rating of breakers is not allowed. System shall be Fully Rated.

D. Circuit breakers shall have automatic, trip free, non-adjustable, inverse time, and instantaneous magnetic trips for less than 400 A frame. Circuit breakers with 400 A frames and above shall have magnetic trip, adjustable from 5x to 10x. Breaker magnetic trip setting shall be set to maximum, unless otherwise noted.

E. Circuit breaker features shall be as follows:

1. A rugged, integral housing of molded insulating material.
2. Silver alloy contacts.
3. Arc quenchers and phase barriers for each pole.
4. Quick-make, quick-break, operating mechanisms.
5. A trip element for each pole, thermal magnetic type with long time delay and instantaneous characteristics, a common trip bar for all poles and a single operator.
6. Electrically and mechanically trip free.
7. An operating handle which indicates closed, tripped, and open positions.
8. An overload on one pole of a multi-pole breaker shall automatically cause all the poles of the breaker to open.
9. Ground fault current interrupting breakers, shunt trip breakers, lighting control breakers (including accessories to switch line currents), or other accessory devices or functions shall be provided where shown on the drawings.



## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Locate panelboards so that the present and future conduits can be conveniently connected.
- C. Install a printed schedule of circuits in each panelboard. Schedules shall reflect final load descriptions, room numbers, and room names connected to each circuit breaker. Schedules shall be printed on the panelboard directory cards and be installed in the appropriate panelboards.
- D. Mount panelboards such that the maximum height of the top circuit breaker above the finished floor shall not exceed 1980 mm (78 inches).
- E. Provide blank cover for each unused circuit breaker mounting space.
- F. Panelboard enclosures shall not be used for conductors feeding through, spliced, or tapping off to other enclosures or devices.

### 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.
    - c. Verify appropriate anchorage and required area clearances.
    - d. Verify that circuit breaker sizes and types correspond to approved shop drawings.

END OF SECTION



SECTION 26 25 00  
EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaries and accessories.

1.2 REFERENCES

- A. IES RP-20 - Lighting for Parking Facilities.
- B. IES RP-29 – Lighting for Hospitals and Healthcare Facilities
- C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 - Submittals: Procedures for submittals.
- B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard Product of the manufacturer.
- C. Product Data: Provide dimensions, ratings, and performance data.

1.4 SUBMITTALS FOR INFORMATION

- A. Section 01 33 00 - Submittals: Submittals for information.
- B. Test Reports: Indicate measured illumination levels.
- C. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Maintenance Data: For each luminaire.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.



## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Materials and Equipment: Transport, handle, store, and protect products.

## PART 2 PRODUCTS

### 2.1 LUMINAIRES AND ACCESSORIES

- A. Manufacturers:
  - a. As indicated on the light fixture schedule or approved equals

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. Install all equipment in accordance with Federal, State and Local Electrical Codes.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Controls.
- B. Operate each luminaire after installation and connection. Inspect for improper connections and operation.
- C. Measure illumination levels to verify conformance with performance requirements.
- D. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

### 3.3 CLEANING

- A. Clean electrical parts to remove conductive and deleterious materials.
- B. Remove dirt and debris from enclosure.
- C. Clean photometric control surfaces as recommended by manufacturer.
- D. Clean finishes and touch up damage.

### 3.4 PROTECTION OF FINISHED WORK

- A. Relamp luminaires which have failed lamps at Substantial Completion.

END OF SECTION



## SECTION 26 27 26

### WIRING DEVICES

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, connection, and testing of wiring devices.

##### 1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations: General electrical requirements that are common to more than one section of Division 26.
- B. Section 26 05 33, Raceway and Boxes for Electrical Systems: Conduit and boxes.
- C. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables: Cables and wiring.
- D. Section 26 05 26, Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path to ground for possible ground fault currents.

##### 1.3 SUBMITTALS

- A. Submit the following in accordance with Section 26 05 11, Requirements for Electrical Installations.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Include electrical ratings, dimensions, mounting details, construction materials, grade, and termination information.
- B. See Section 26 05 11, Requirements for Electrical Installations, Article 1.12 Submittals for further requirements.
- C. See Section 26 05 11, Requirements for Electrical Installations, Article 1.4 Quality Assurance for further requirements.

##### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by basic designation only.
- B. National Fire Protection Association (NFPA):
  - 70-11 .....National Electrical Code (NEC)
  - 99-12 .....Health Care Facilities



- C. National Electrical Manufacturers Association (NEMA):
  - WD 1-10.....General Color Requirements for Wiring Devices
  - WD 6-08 .....Wiring Devices – Dimensional Specifications
- D. Underwriter’s Laboratories, Inc. (UL):
  - 5-11 .....Surface Metal Raceways and Fittings
  - 20-10 .....General-Use Snap Switches
  - 231-07 .....Power Outlets
  - 467-07 .....Grounding and Bonding Equipment
  - 498-07 .....Attachment Plugs and Receptacles
  - 943-11 .....Ground-Fault Circuit-Interruptioners
  - 1449-07 .....Surge Protective Devices
  - 1472-96 .....Solid State Dimming Controls

## PART 2 - PRODUCTS

### 2.1 RECEPTACLES

- A. General: All receptacles shall comply with NEMA, NFPA, UL, and as specified on the drawings or approved equal.
- B. Verify color with Architect/Engineer.

### 2.2 TOGGLE SWITCHES

- A. Toggle switches shall be as specified on the drawings or approved equal.
- B. Verify color with Architect/Engineer.

### 2.3 WALL PLATES

- A. Wall plates for switches as specified on the drawings or approved equal.
- B. Verify color & type with Architect/Engineer.
- C. For receptacles or switches mounted adjacent to each other, wall plates shall be common for each group of receptacles or switches.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Installation shall be in accordance with the NEC and as shown as on the drawings.
- B. Install wiring devices after wall construction and painting is complete.





- C. The ground terminal of each wiring device shall be bonded to the outlet box with an approved green bonding jumper, and also connected to the branch circuit equipment grounding conductor.
- D. Outlet boxes for toggle switches and manual dimming controls shall be mounted on the strike side of doors.
- E. Provide barriers in multigang outlet boxes to comply with the NEC.
- F. Coordinate the electrical work with the work of other trades to ensure that wiring device flush outlets are positioned with box openings aligned with the face of the surrounding finish material.
- G. Exact field locations of floors, walls, partitions, doors, windows, and equipment may vary from locations shown on the drawings. Prior to locating sleeves, boxes and chases for roughing-in of conduit and equipment, the Contractor shall coordinate exact field location of the above items with other trades.
- H. Install wall switches 1.2 M (48 inches) above floor, with the toggle OFF position down.
- I. Install wall dimmers 1.2 M (48 inches) above floor.
- J. Install receptacles 450 mm (18 inches) above floor, and 152 mm (6 inches) above counter backsplash or workbenches. Install specific-use receptacles at heights shown on the drawings.
- K. Install vertically mounted receptacles with the ground pin up. Install horizontally mounted receptacles with the ground pin to the right.
- L. When required or recommended by the manufacturer, use a torque screwdriver. Tighten unused terminal screws.

### 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform manufacturer's required field checks in accordance with the manufacturer's recommendations. In addition, include the following:
  - 1. Visual Inspection and Tests:
    - a. Inspect physical and electrical condition.
    - b. Vacuum-clean surface metal raceway interior. Clean metal raceway exterior.
    - c. Test wiring devices for damaged conductors, high circuit resistance, poor connections, inadequate fault current path, defective devices, or similar problems using a portable receptacle tester. Correct circuit conditions, remove malfunctioning units and replace with new, and retest as specified above.
    - d. Test GFCI receptacles.

END OF SECTION



## SECTION 26 28 13

### FUSES

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Cartridge fuses rated 600 V ac and less for use in the following:
    - a. Control circuits.
    - b. Enclosed controllers.
    - c. Enclosed switches.
  - 2. Spare-fuse cabinets.

##### 1.03 SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
  - 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
    - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
    - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
  - 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
  - 3. Current-limitation curves for fuses with current-limiting characteristics.
  - 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
  - 5. Coordination charts and tables and related data.
  - 6. Fuse sizes for elevator feeders and elevator disconnect switches.

##### 1.04 MAINTENANCE MATERIAL

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.



## 1.05 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

## PART 2 - PRODUCTS

### 2.01 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bussmann, an Eaton business.
  - 2. Edison; a brand of Bussmann by Eaton.
  - 3. Littelfuse, Inc.
  - 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

### 2.02 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
  - 1. Type RK-1: 250 or 600-V, zero- to 600-A rating, 200 kAIC.
  - 2. Type T: 250-V, zero- to 1200-A rating, 200 kAIC, very fast acting.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with NFPA 70.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.
- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.



- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 FUSE APPLICATIONS

- A. Cartridge Fuses:
  - 1. Feeders: Class RK1, fast acting.
  - 2. Motor Branch Circuits: Class RK1, time delay.
  - 3. Large Motor Branch (601-4000 A): Class L, time delay.
  - 4. Power Electronics Circuits: Class T, fast acting.
  - 5. Other Branch Circuits: Class RK1, time delay.
  - 6. Control Transformer Circuits: Class CC, time delay, control transformer duty.
  - 7. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

### 3.03 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location as indicated in the field by Owner.

### 3.04 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION



## SECTION 26 29 21

### ENCLOSED SWITCHES AND CIRCUIT BREAKERS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section specifies the furnishing, installation, and connection of fused and unfused disconnect switches (indicated as switches in this section), and separately enclosed circuit breakers for use in electrical systems rated 600 V and below.

##### 1.2 RELATED WORK

- A. Section 26 05 11, Requirements for Electrical Installations: Requirements that apply to all sections of Division 26.
- B. Section 26 05 19, Low-Voltage Electrical Power Conductors and Cables: Low-voltage conductors.
- C. Section 26 05 26, Grounding and Bonding for Electrical Systems: Requirements for personnel safety and to provide a low impedance path for possible ground faults.
- D. Section 26 05 33, Raceway and Boxes for Electrical Systems: Conduits.
- E. Section 26 24 16, Panelboards: Molded-case circuit breakers.

##### 1.3 SUBMITTALS

- A. Submit six copies of the following in accordance with Section 26 05 11, Requirements for Electrical Installations.
  - 1. Shop Drawings:
    - a. Submit sufficient information to demonstrate compliance with drawings and specifications.
    - b. Submit the following data for approval:
      - 1) Electrical ratings, dimensions, mounting details, materials, required clearances, terminations, weight, fuses, circuit breakers, wiring and connection diagrams, accessories, and device nameplate data.
  - 2. Manuals:
    - a. Submit complete maintenance and operating manuals including technical data sheets, wiring diagrams, and information for ordering fuses, circuit breakers, and replacement parts.
      - 1) Include schematic diagrams, with all terminals identified, matching terminal identification in the enclosed switches and circuit breakers.
      - 2) Include information for testing, repair, troubleshooting, assembly, and disassembly.



- B. See Section 26 05 11, Requirements for Electrical Installations, Article 1.12 Submittals for further requirements.
- C. See Section 26 05 11, Requirements for Electrical Installations, Article 1.6 Quality Assurance for further requirements.

#### 1.4 APPLICABLE PUBLICATIONS

- A. Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this specification to the extent referenced. Publications are referenced in the text by designation only.
- B. International Code Council (ICC):  
IBC-12.....International Building Code
- C. National Electrical Manufacturers Association (NEMA):  
FU 1-07 .....Low Voltage Cartridge Fuses  
KS 1-06 .....Enclosed and Miscellaneous Distribution Equipment  
Switches (600 Volts Maximum)
- D. National Fire Protection Association (NFPA):  
70-11 .....National Electrical Code (NEC)
- E. Underwriters Laboratories, Inc. (UL):  
98-07 .....Enclosed and Dead-Front Switches  
248-00 .....Low Voltage Fuses  
489-09 .....Molded Case Circuit Breakers and Circuit Breaker Enclosures

#### PART 2 - PRODUCTS

##### 2.1 FUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Switches shall be in accordance with NEMA, NEC, UL, as specified, and as shown on the drawings.
- B. Shall be NEMA classified General Duty (GD) for 240 V switches, and NEMA classified Heavy Duty (HD) for 480 V switches.
- C. Shall be horsepower (HP) rated.
- D. Shall have the following features:
  - 1. Switch mechanism shall be the quick-make, quick-break type.
  - 2. Copper blades, visible in the open position.
  - 3. An arc chute for each pole.
  - 4. External operating handle shall indicate open and closed positions and have lock-open padlocking provisions.
  - 5. Mechanical interlock shall permit opening of the door only when the switch is in the open position, defeatable to permit inspection.
  - 6. Fuse holders for the sizes and types of fuses specified.



7. Solid neutral for each switch being installed in a circuit which includes a neutral conductor.
8. Ground lugs for each ground conductor.
9. Enclosures:
  - a. Shall be the NEMA types shown on the drawings.
  - b. Where the types of switch enclosures are not shown, they shall be the NEMA types most suitable for the ambient environmental conditions.
  - c. Shall be finished with manufacturer's standard gray baked enamel paint over pretreated steel.

## 2.2 UNFUSED SWITCHES RATED 600 AMPERES AND LESS

- A. Shall be the same as fused switches, but without provisions for fuses.

## 2.3 MOTOR RATED TOGGLE SWITCHES

- A. Type 1, general purpose for single-phase motors rated up to 1 horsepower.
- B. Quick-make, quick-break toggle switch with external reset button and thermal overload protection matched to nameplate full-load current of actual protected motor.

## 2.4 SEPARATELY ENCLOSED CIRCUIT BREAKERS

- A. Provide circuit breakers in accordance with the applicable requirements in Section 26 24 16, Panelboards.
- B. Enclosures shall be the NEMA types shown on the drawings. Where the types are not shown, they shall be the NEMA type most suitable for the ambient environmental conditions.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Installation shall be in accordance with the manufacturer's instructions, the NEC, as shown on the drawings, and as specified.
- B. Fused switches shall be furnished complete with fuses. Arrange fuses such that rating information is readable without removing the fuses.

## 3.2 ACCEPTANCE CHECKS AND TESTS

- A. Perform in accordance with the manufacturer's recommendations. In addition, include the following:
  1. Visual Inspection and Tests:
    - a. Compare equipment nameplate data with specifications and approved shop drawings.
    - b. Inspect physical, electrical, and mechanical condition.
    - c. Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method.
    - d. Vacuum-clean enclosure interior. Clean enclosure exterior.



### 3.3 SPARE PARTS

- A. Two weeks prior to the final inspection, furnish one complete set of spare fuses for each fused disconnect switch installed on the project. Deliver the spare fuses to the Owner.

END OF SECTION





## SECTION 26 43 13

### SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

#### 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 field-mounted SPDs for low-voltage (120 to 600 V) power distribution and control equipment.
- B. Related Requirements:

##### 1.3 DEFINITIONS

- A. Inominal: Nominal discharge current.
- B. MCOV: Maximum continuous operating voltage.
- C. Mode(s), also Modes of Protection: The pair of electrical connections where the VPR applies.
- D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
- E. OCPD: Overcurrent protective device.
- F. SCCR: Short-circuit current rating.
- G. SPD: Surge protective device.
- H. VPR: Voltage protection rating.

##### 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.
  - 2. Copy of UL Category Code VZCA certification, as a minimum, listing the tested values for VPRs, Inominal ratings, MCOVs, type designations, OCPD requirements, model numbers, system voltages, and modes of protection.

##### 1.5 INFORMATIONAL SUBMITTALS

- A. Field quality-control reports.



- B. Sample Warranty: For manufacturer's special warranty.

## 1.6 CLOSEOUT SUBMITTALS

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

## 1.7 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to replace or replace SPDs 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 SPD REQUIREMENTS

- A. SPD with 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.
- C. Comply with UL 1449.
- D. MCOV of the SPD shall be the nominal system voltage.

### 2.2 SERVICE ENTRANCE AND TRANSFER SWITCH SUPPRESSOR

- A. Manufactures
  - 1. ABB
  - 2. Advanced Protection Technologies
  - 3. Eaton
  - 4. Intermatic
  - 5. Leviton
  - 6. Schneider Electric
  - 7. Siemens
  - 8. SSI and ILSCO Company
- B. SPDs: Comply with UL 1449, Type 1.
- C. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 1.
  - 1. SPDs with the following features and accessories:
    - a. Integral disconnect switch.
    - b. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
    - c. Indicator light display for protection status.
- D. Comply with UL 1283.



- E. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- F. SCCR: Equal or exceed 200 kA.
- G. Inominal Rating: 20 kA.

## 2.3 PANEL SUPPRESSORS

- A. Manufactures
  - 1. ABB
  - 2. Advanced Protection Technologies
  - 3. Eaton
  - 4. Intermatic
  - 5. Leviton
  - 6. Schneider Electric
  - 7. Siemens
  - 8. SSI and ILSCO Company
- B. SPDs: Comply with UL 1449, Type 2.
  - 1. Include LED indicator lights for power and protection status.
  - 2. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
- C. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 100 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.
- D. Comply with UL 1283.
- E. Protection modes and UL 1449 VPR for 240/120-V, single-phase, three-wire circuits shall not exceed the following:
  - 1. Line to Neutral: 700 V.
  - 2. Line to Ground: 700 V.
  - 3. Neutral to Ground: 700 V.
  - 4. Line to Line: 1200 V.
- F. SCCR: Equal or exceed 200 kA.
- G. Inominal Rating: 20 kA.

## 2.4 ENCLOSURES

- A. Indoor Enclosures: NEMA 250, Type 1.
- B. Outdoor Enclosures: NEMA 250, Type 3R.



## 2.5 CONDUCTORS AND CABLES

- A. Power Wiring: Same size as SPD leads, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cables: Multiconductor cable with copper conductors not smaller than No. 18 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cables: Multiconductor cable with copper conductors not smaller than No. 14 AWG, complying with Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Comply with NECA 1.
- B. Install an OCPD or disconnect as required to comply with the UL listing of the SPD.
- C. Install SPDs with conductors between suppressor and points of attachment as short and straight as possible and adjust circuit-breaker positions to achieve shortest and straightest leads. Do not splice and extend SPD leads unless specifically permitted by manufacturer. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.
- D. Use crimped connectors and splices only. Wire nuts are unacceptable.
- E. Wiring:
  - 1. Power Wiring: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
  - 2. Controls: Comply with wiring methods in Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

### 3.2 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative.
  - 1. Compare equipment nameplate data for compliance with Drawings and Specifications.
  - 2. Inspect anchorage, alignment, grounding, and clearances.
  - 3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.
- B. An SPD will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.



### 3.3 STARTUP SERVICE

- A. Complete startup checks according to manufacturer's written instructions.
- B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests and reconnect them immediately after the testing is over.
- C. Energize SPDs after power system has been energized, stabilized, and tested.

### 3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION



## SECTION 26 51 00

### INTERIOR LIGHTING

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. This Section includes the following:
  - 1. Interior lighting fixtures with lamps and Drivers.
  - 2. Emergency lighting units.
  - 3. Exit signs.
  - 4. Light fixture supports.
- B. Related Sections include the following:
  - 1. Section 26 27 26, "Wiring Devices" for manual wall-box switching.

##### 1.03 DEFINITIONS

- A. CRI: Color rendering index.
- B. CU: Coefficient of utilization.
- C. LER: Luminaire efficiency rating, which is calculated according to NEMA LE 5. This value can be estimated from photometric data using the following formula:
  - 1. LER is equal to the product of total rated lamp lumens times BF times luminaire efficiency, divided by input watts.
- D. RCR: Room cavity ratio.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting fixture.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of lighting fixture scheduled, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of fixture, including dimensions and verification of indicated parameters.
  - 2. Emergency lighting unit battery and charger.
- B. Shop Drawings: Show details of nonstandard or custom fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
- C. Wiring Diagrams: Power, signal, and control wiring.
- D. Product Certificates: For each type of driver for dimmer-controlled fixtures, signed by product manufacturer.



- E. Source quality-control test reports.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section, "Operation and Maintenance Data," include the following:
  - 1. Catalog data for each fixture. Include the diffuser, driver, and lamps installed in that fixture.
- H. Warranties: Special warranties specified in this Section.

#### 1.05 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.
- C. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

#### 1.06 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.

#### 1.07 WARRANTY

- A. Special Warranty for Emergency Lighting Unit 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: Ten years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.

#### 1.08 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. Plastic Diffusers and Lenses: 5 for every 100 of each type and rating installed. Furnish at least one of each type.
  - 2. Battery and Charger Data: One for each emergency lighting unit.
  - 3. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

### PART 2 - PRODUCTS

#### 2.01 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 the manufacturers specified.



## 2.02 FIXTURES AND COMPONENTS, GENERAL

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- C. 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.
- D. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metallized Film: 90 percent.
- E. Plastic Diffusers, Covers, 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 inches minimum unless different thickness is scheduled.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.

## 2.03 LIGHTING FIXTURES

- A. Fixtures to be as designated on the drawings in the Light Fixture Schedule.

## 2.04 LED LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. Recessed Fixtures: Comply with NEMA LE 4.
- E. Bulb shape complying with ANSI C79.1.
- F. Lamp base complying with ANSI C81.61.
- G. CRI of minimum 80. CCT of 4100 K.
- H. Rated lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.





- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
  - 1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
- L. Housings:
  - 1. Extruded-aluminum housing and heat sink.
  - 2. Clear painted finish.

## 2.05 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section 26 05 11, "Requirements for Electrical Installations" 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, 12 AWG or as specified.
- E. Wires For Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 AWG or as specified.
- 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.
- H. Aircraft Cable Support: Use cable, anchorages, and intermediate supports recommended by fixture manufacturer.

## 2.06 FINISHES

- A. Fixtures: Manufacturers' standard, unless otherwise indicated.
  - 1. Paint Finish: Applied over corrosion-resistant treatment or primer, free of defects.
  - 2. Metallic Finish: Corrosion resistant.

## 2.7 SOURCE QUALITY CONTROL

- A. Provide services of a qualified, independent testing and inspecting agency to factory test fixtures with Drivers and LEDs; certify results for electrical ratings and photometric data.

# PART 3 - EXECUTION

## 3.01 INSTALLATION

- A. Fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.



2. Support Clips: Fasten to 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.

C. Suspended Fixture Support: As follows:

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. Continuous Rows: Suspend from cable.

D. Adjust aimable fixtures to provide required light intensities.

### 3.02 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.03 FIELD QUALITY CONTROL

- A. Inspect each installed fixture for damage. Replace damaged fixtures and components.
- B. Verify normal operation of each fixture after installation.
- C. 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.
- D. Corroded Fixtures: During warranty period, replace fixtures that show any signs of corrosion.

END OF SECTION



## SECTION 27 05 26

### GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Grounding conductors.
  - 2. Grounding connectors.
  - 3. Grounding busbars.
  - 4. Grounding rods.
  - 5. Grounding labeling.

##### 1.03 DEFINITIONS

- A. BCT: Bonding conductor for telecommunications.
- B. TGB: Telecommunications grounding busbar.
- C. TMGB: Telecommunications main grounding busbar.
- D. Service Provider: The operator of a service that provides telecommunications transmission delivered over access provider facilities.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For communications equipment room signal reference grid. Include plans, elevations, sections, details, and attachments to other work.
- C. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:
  - 1. Ground rods.
  - 2. BCT, TMGB, TGBs, and routing of their bonding conductors.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
  - 1. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:
    - a. Result of the ground-resistance test, measured at the point of BCT connection.
    - b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.



## 1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of ITS Technician, who shall be present at all times when Work of this Section is performed at Project site.
  - 2. Field Inspector: Currently registered by BICSI as a designer RCDD to perform the on-site inspection.

## PART 2 - PRODUCTS

### 2.01 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.
- C. Comply with TIA-607-B.

### 2.02 CONDUCTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Harger Lightning & Grounding.
  - 2. Panduit Corp.
  - 3. TE Connectivity Ltd.
- B. Comply with UL 486A-486B.
- C. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.
  - 1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.
- D. Cable Tray Grounding Jumper:
  - 1. Not smaller than No. 6 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with two holes and long barrel for two crimps. If jumper is a flexible braid, it shall have a one-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
  - 2. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.
- E. 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 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

## 2.03 CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Burndy; Part of Hubbell Electrical Systems.
  2. Chatsworth Products, Inc.
  3. Harger Lightning & Grounding.
  4. Panduit Corp.
  5. TE Connectivity Ltd.
- B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.
- C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.
  1. Electroplated tinned copper, C and H shaped.
- D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.
- E. Busbar Connectors: Cast silicon bronze, solderless compression type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.
- F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.04 GROUNDING BUSBARS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Chatsworth Products, Inc.
  2. Harger Lightning & Grounding.
  3. Panduit Corp.
- B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, 20" in length. The busbar shall be NRTL listed for use as TMGB and shall comply with TIA-607-B.
  1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.



3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.
- C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, 20" in length. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with TIA-607-B.
  1. Predrilling shall be with holes for use with lugs specified in this Section.
  2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
  3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

## 2.05 GROUND RODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Harger Lightning & Grounding.
  2. TE Connectivity Ltd.
- B. Ground Rods: Copper-clad steel, 3/4 inch by 10 feet in diameter.

## 2.06 IDENTIFICATION

- A. Comply with requirements for identification products in Section 27 0553 "Identification for Communications Systems."

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.
- B. Inspect the test results of the ac grounding system measured at the point of BCT connection.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

## 3.02 INSTALLATION

- A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.
- B. Comply with NECA 1.
- C. Comply with TIA-607-B.



### 3.03 APPLICATION

- A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
  - 1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
  - 2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
- B. Underground Grounding Conductors: Install bare copper conductor, No. 2 AWG minimum.
- 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.
- D. Conductor Support:
  - 1. Secure grounding and bonding conductors at intervals of not less than 36 inches.
- E. Grounding and Bonding Conductors:
  - 1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
  - 2. Install without splices.
  - 3. Support at not more than 36-inch intervals.
  - 4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.
    - a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 27 0528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

### 3.04 GROUNDING ELECTRODE SYSTEM

- A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

### 3.05 CONNECTIONS

- A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.
- B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.



- C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:
    - 1. Use crimping tool and the die specific to the connector.
    - 2. Pretwist the conductor.
    - 3. Apply an antioxidant compound to all bolted and compression connections.
  - D. Primary Protector: Bond to the TMGB with insulated bonding conductor.
  - E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.
  - F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.
  - G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.
  - H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.
  - I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA-568-C.1 and TIA-568-C.2 when grounding shielded balanced twisted-pair cables.
  - J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.
  - K. Static Floors: Bond all metal parts of access floors to the TGB.
  - L. Towers and Antennas:
    - 1. Waveguides and Coaxial Cable:
      - a. Bond cable shields at the point of entry into the building to the TGB and to the cable entrance plate, using No. 2 AWG bonding conductors.
      - b. Bond coaxial cable surge arrester to the ground or roof ring using bonding conductor size recommended by surge-arrester manufacturer.
- 3.06 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS
- A. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.





### 3.07 IDENTIFICATION

- A. Labels shall be preprinted or computer-printed type.
  - 1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
  - 2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
  - 3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

### 3.08 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
  - 2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.
    - a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.
  - 3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.
    - a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.
- C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION



## SECTION 27 05 28

### PATHWAYS FOR COMMUNICATIONS AND SECURITY SYSTEMS

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Metal conduits and fittings.
  - 2. Surface pathways.
  - 3. Boxes, enclosures, and cabinets.
- B. Related Requirements:
  - 1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.

##### 1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.04 SUBMITTALS

- A. Product Data: For conduits, fittings, surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- D. Qualification Data: For professional engineer.



- E. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, equipment racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- F. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.01 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems; a part of Atkore International.
  - 2. Allied Tube & Conduit; a part of Atkore International.
  - 3. Alpha Wire.
  - 4. Anamet Electrical, Inc.
  - 5. Electri-Flex Company.
  - 6. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 7. Picoma Industries, Inc.
  - 8. Republic Conduit.
  - 9. Robroy Industries.
  - 10. Southwire Company.
  - 11. Thomas & Betts Corporation, A Member of the ABB Group.
  - 12. Western Tube and Conduit Corporation.
  - 13. Wheatland Tube Company.
- B. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Compression.



2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
  3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- G. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

## 2.02 SURFACE PATHWAYS

- A. General Requirements for Surface Pathways:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Comply with TIA-569-B.
- B. Surface Metal Pathways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Panduit Corp.
    - b. Wiremold / Legrand.

## 2.03 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carlon; a brand of Thomas & Betts Corporation.
  2. Crouse-Hinds, an Eaton business.
  3. EGS/Appleton Electric.
  4. Erickson Electrical Equipment Company.
  5. Hoffman; a brand of Pentair Equipment Protection.
  6. Milbank Manufacturing Co.
  7. O-Z/Gedney; a brand of Emerson Industrial Automation.
  8. Quazite: Hubbell Power Systems, Inc.
  9. RACO; Hubbell.
  10. Robroy Industries.
  11. Spring City Electrical Manufacturing Company.
  12. Thomas & Betts Corporation, A Member of the ABB Group.
  13. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
1. Comply with TIA-569-B.
  2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.



- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. 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.
- G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- J. Gangable boxes are prohibited.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.01 PATHWAY APPLICATION

- A. Outdoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed Conduit: GRC, IMC.
  - 2. Concealed Conduit, Aboveground: EMT.
  - 3. Underground Conduit: RNC, Type EPC-40-PVC.
  - 4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.



- B. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Damp or Wet Locations: GRC.
  - 6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
  - 7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
  - 8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: EMT.
  - 9. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in damp or wet locations.
- C. Minimum Pathway Size: 1 inch trade size. Minimum size for optical-fiber cables is 1 inch.
- D. Pathway Fittings: Compatible with pathways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
  - 3. EMT: Use compression or steel fittings. Comply with NEMA FB 2.10.
- E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- F. Install surface pathways only where indicated on Drawings.
- G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.



- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange pathways 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 or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. 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.



- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lbtensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- R. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- S. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- T. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- U. 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.
  - V. 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.
  - W. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
  - X. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - Y. 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.
  - Z. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - AA. Set metal floor boxes level and flush with finished floor surface.
  - BB. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies.
- 3.04 PROTECTION
- A. Protect coatings, finishes, and cabinets from damage or 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



## SECTION 27 15 00

### COMMUNICATIONS HORIZONTAL CABLING

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. UTP cabling.
  - 2. Telecommunications outlet/connectors.
  - 3. Cabling system identification products.
  - 4. Cable management system.
  - 5. Cable connecting hardware, patch panels, and cross-connects.

##### 1.3 ABBREVIATIONS

- A. BICSI: Building Industry Consulting Service International.
- B. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- C. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. LAN: Local area network.
- G. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- H. RCDD: Registered Communications Distribution Designer.
- I. UTP: Unshielded twisted pair.

##### 1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.
- B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.



## 1.5 ACTION SUBMITTALS

- A. Shop Drawings:
  - 1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.
  - 2. Cabling administration drawings and printouts.
  - 3. Wiring diagrams to show typical wiring schematics, including the following:
    - a. Cross-connects.
    - b. Patch panels.
    - c. Patch cords.
  - 4. Cross-connects and patch panels. Detail mounting assemblies and show elevations and physical relationship between the installed components.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer, installation supervisor, and field inspector.
- B. Source quality-control reports.
- C. Field quality-control reports.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For splices and connectors to include in maintenance manuals.

## 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. Patch-Panel Units: One of each type.
  - 2. Connecting Blocks: One of each type.
  - 3. Device Plates: One of each type.

## 1.9 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, and field testing program development.
  - 2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

## 1.10 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.
  - 1. Test each pair of UTP cable for open and short circuits.



## PART 2 - PRODUCTS

### 2.1 HORIZONTAL CABLING DESCRIPTION

- A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.
  - 1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
  - 2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
  - 3. Bridged taps and splices shall not be installed in the horizontal cabling.
- B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

### 2.2 PERFORMANCE REQUIREMENTS

- A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- D. Grounding: Comply with J-STD-607-A.

### 2.3 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements in Section 06 10 23 "Miscellaneous Rough Carpentry" for plywood backing panels.

### 2.4 UTP CABLE

- A. Manufacturers
  - 1. 3M
  - 2. Belden
  - 3. Berk-Tek



4. CommScope
5. General Cable
6. Mohawk Cable
7. Prysmian
8. Superior Essex Inc.

- B. Description: 100-ohm, four-pair UTP, formed into 25-pair, binder groups covered with a blue thermoplastic jacket.
1. Comply with ICEA S-90-661 for mechanical properties.
  2. Comply with TIA/EIA-568-B.1 for performance specifications.
  3. Comply with TIA/EIA-568-B.2, Category 6.
  4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG
    - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Multipurpose: Type MP or MPG.
    - e. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - f. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

## 2.5 UTP CABLE HARDWARE

- A. Manufactures
1. Belden
  2. Dynacom Corporation
  3. Hubbell Premise Wiring
  4. Leviton
  5. Panduit Corp.
  6. Siemon Co.
- B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.
- C. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- D. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
1. Number of Jacks per Field: One for each four-pair UTP cable indicated.
- E. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.
- F. Patch Cords: Factory-made, four-pair cables in 36" lengths; terminated with eight-position modular plug at each end.



1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6 performance. Patch cords shall have latch guards to protect against snagging.

## 2.6 CONSOLIDATION POINTS

- A. Manufactures
  1. American Technology Systems
  2. Belden
  3. Chatsworth Products Inc.
  4. Dynacom Corporation
  5. Hubbell Premise Wiring
  6. Ortronics, Inc.
  7. Panduit Corp.
  8. Siemon Co.
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
  1. Number of Terminals per Field: One for each conductor in assigned cables.
  2. Number of Connectors per Field:
    - a. One for each four-pair UTP cable indicated.
    - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
  3. Mounting: Recessed in ceiling.
  4. NRTL listed as complying with UL 50 and UL 1863.
  5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

## 2.7 CONSOLIDATION POINTS

- A. Manufactures
  1. American Technology Systems
  2. Belden
  3. Chatsworth Products Inc.
  4. Dynacom Corporation
  5. Hubbell Premise Wiring
  6. Ortronics, Inc.
  7. Panduit Corp.
  8. Siemon Co.
- B. Description: Consolidation points shall comply with requirements for cable connecting hardware.
  1. Number of Terminals per Field: One for each conductor in assigned cables.
  2. Number of Connectors per Field:
    - a. One for each four-pair UTP cable indicated.
    - b. One for each four-pair conductor group of indicated cables, plus 25 percent spare positions.
  3. Mounting: Recessed in ceiling.



4. NRTL listed as complying with UL 50 and UL 1863.
5. When installed in plenums used for environmental air, NRTL listed as complying with UL 2043.

## 2.8 TELECOMMUNICATIONS OUTLET/CONNECTORS

- A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.
- B. Data Outlets: Four port-connector assemblies mounted in single or multigang faceplate.
  1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 26 27 26 "Wiring Devices."
  2. For use with snap-in jacks accommodating any combination of UTP work area cords.
    - a. Flush mounting jacks, positioning the cord at a 45-degree angle.
  3. Legend: Machine printed, in the field, using adhesive-tape label.
  4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

## 2.9 GROUNDING

- A. Comply with J-STD-607-A.

## 2.10 IDENTIFICATION PRODUCTS

- A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.
- B. Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

## 2.11 SOURCE QUALITY CONTROL

- A. Factory test UTP cables according to TIA/EIA-568-B.2.
- B. Cable will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

# PART 3 - EXECUTION

## 3.1 ENTRANCE FACILITIES

- A. Coordinate demarcation point provided by communications service provider.

## 3.2 WIRING METHODS

- A. Install cables in pathways except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.
  1. Install plenum cable in environmental air spaces, including plenum ceilings.



2. Comply with requirements in Section 27 05 28 "Pathways for Communications Systems."

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

### 3.3 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. MUTOA shall not be used as a cross-connect point.
5. Consolidation points may be used only for making a direct connection to telecommunications outlet/connectors:
  - a. Do not use consolidation point as a cross-connect point, as a patch connection, or for direct connection to workstation equipment.
  - b. Locate consolidation points for UTP at least 49 feet from communications equipment room.
6. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
7. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
8. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
9. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
10. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
11. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
12. In the communications equipment room, install a 10-foot- long service loop on each end of cable.
13. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.





- C. UTP Cable Installation:
  - 1. Comply with TIA/EIA-568-B.2.
  - 2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.
- D. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.
  - 3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.
- E. Group connecting hardware for cables into separate logical fields.
- F. Separation from EMI Sources:
  - 1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
  - 2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches
  - 3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches.
  - 4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
    - a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    - b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches
    - c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches.
  - 5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
  - 6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

### 3.4 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.



- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.
- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.5 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems."
  - 1. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.
- B. Comply with requirements in Section 09 90 00 "Painting and Coating" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.
- C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.
- D. Cable and Wire Identification:
  - 1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
  - 2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
  - 3. Exposed Cables and Cables in Wire Troughs: Label each at intervals not exceeding 15 feet.
  - 4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.
    - a. Individually number wiring conductors connected to terminal strips and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    - b. Label each unit and field within distribution racks and frames.
  - 5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.
  - 6. Uniquely identify and label work area cables extending from the MUTOA to the work area. These cables may not exceed the length stated on the MUTOA label.
- E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.
  - 1. Cables use flexible vinyl or polyester that flex as cables are bent.



### 3.6 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections
  - 1. Visually inspect UTP cable jacket materials for NRTL certification markings. Inspect cabling terminations in equipment rooms for compliance with color-coding for pin assignments and inspect connections for compliance with TIA/EIA-568-B.1.
  - 2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.
  - 3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
  - 5. UTP Performance Tests:
    - a. Test for each outlet and MUTOA. Perform the following tests according to TIA/EIA-568-B.1 and TIA/EIA-568-B.2:
      - 1) Wire map.
      - 2) Length (physical vs. electrical, and length requirements).
      - 3) Insertion loss.
      - 4) Near-end crosstalk (NEXT) loss.
      - 5) Power sum near-end crosstalk (PSNEXT) loss.
      - 6) Equal-level far-end crosstalk (ELFEXT).
      - 7) Power sum equal-level far-end crosstalk (PSELFEXT).
      - 8) Return loss.
      - 9) Propagation delay.
      - 10) Delay skew.
  - 6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.
    - a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.
    - b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.
- B. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted similar to Table 10.1 in BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.



- C. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.7 DEMONSTRATION

- A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION



## SECTION 28 05 28

### PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Metal conduits, tubing, and fittings.
  - 2. Nonmetallic conduits, tubing, and fittings.
  - 3. Optical-fiber-cable pathways and fittings.
  - 4. Metal wireways and auxiliary gutters.
  - 5. Nonmetallic wireways and auxiliary gutters.
  - 6. Surface pathways.
  - 7. Boxes, enclosures, and cabinets.
  - 8. Handholes and boxes for exterior underground cabling.
- B. Related Requirements:
  - 1. Section 26 05 33 "Raceways and Boxes for Electrical Systems" for conduits, wireways, surface raceways, boxes, enclosures, cabinets, handholes, and faceplate adapters serving electrical systems.
  - 2. Section 27 05 28 "Pathways for Communications Systems" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving communications systems.

##### 1.03 DEFINITIONS

- A. ARC: Aluminum rigid conduit.
- B. GRC: Galvanized rigid steel conduit.
- C. IMC: Intermediate metal conduit.

##### 1.04 SUBMITTALS

- A. Product Data: For surface pathways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
- C. Coordination Drawings: Pathway routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
  - 1. Structural members in paths of pathway groups with common supports.
  - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.



- D. Seismic Qualification Certificates: For pathway racks, enclosures, cabinets, and equipment racks and their mounting provisions, including those for internal components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.
  - 4. Detailed description of conduit support devices and interconnections on which certification is based and their installation requirements.
- E. Source quality-control reports.

## PART 2 - PRODUCTS

### 2.01 METAL CONDUITS, TUBING, AND FITTINGS

- A. General Requirements for Metal Conduits and Fittings:
  - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- B. GRC: Comply with ANSI C80.1 and UL 6.
- C. ARC: Comply with ANSI C80.5 and UL 6A.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. FMC: Comply with UL 1; zinc-coated steel or aluminum.
- G. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- H. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
  - 1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
  - 2. Fittings for EMT:
    - a. Material: Steel.
    - b. Type: Setscrew.
  - 3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- I. 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.



## 2.02 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. B-line, an Eaton business.
  - 2. Cope Cable Tray; A Part of Atkore International.
  - 3. Hoffman; a brand of Pentair Equipment Protection.
  - 4. MonoSystems, Inc.
  - 5. Square D.
- B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
  - 1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  - 2. Comply with TIA-569-B.
- C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
- D. Wireway Covers: Hinged type unless otherwise indicated.
- E. Finish: Manufacturer's standard enamel finish.

## 2.03 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Adalet.
  - 2. Crouse-Hinds, an Eaton business.
  - 3. EGS/Appleton Electric.
  - 4. Erickson Electrical Equipment Company.
  - 5. Hoffman; a brand of Pentair Equipment Protection.
  - 6. Lamson & Sessions.
  - 7. Milbank Manufacturing Co.
  - 8. Molex Premise Networks.
  - 9. MonoSystems, Inc.
  - 10. O-Z/Gedney; a brand of Emerson Industrial Automation.
  - 11. Plasti-Bond.
  - 12. Quazite: Hubbell Power Systems, Inc.
  - 13. RACO; Hubbell.
  - 14. Spring City Electrical Manufacturing Company.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
  - 1. Comply with TIA-569-B.
  - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.



- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Device Box Dimensions: 4-inches square by 2-1/8 inches deep.
- I. Gangable boxes are prohibited.
- J. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.
  - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
  - 2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- L. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
  - 2. Hinged door in front cover with flush latch and concealed hinge.
  - 3. Key latch to match panelboards.
  - 4. Metal barriers to separate wiring of different systems and voltage.
  - 5. Accessory feet where required for freestanding equipment.
  - 6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## PART 3 - EXECUTION

### 3.01 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
  - 1. Exposed, Not Subject to Physical Damage: EMT.
  - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
  - 3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
  - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
  - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
  - 6. Damp or Wet Locations: IMC.





7. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical-fiber-cable pathway Plenum-type, communications-cable pathway.
  8. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: EMT.
  9. Pathways for Concealed General Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway.
  10. 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.
- B. Minimum Pathway Size: 3/4-inch trade size. Minimum size for optical-fiber cables is 1 inch.
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
  2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.
  3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.
- D. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- E. Install surface pathways only where indicated on Drawings.
- F. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

### 3.02 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 26 05 29 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches 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. Pathways 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 pathways to reinforcement at maximum 10-foot intervals.
  - 2. Arrange pathways to cross building expansion joints at right angles with expansion fittings.
  - 3. Arrange pathways to keep a minimum of 1 inch 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 or IMC before rising above floor.
- J. Stub-ups to Above Recessed Ceilings:
  - 1. Use EMT, IMC, or RMC for pathways.
  - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- L. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.
- M. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- N. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- O. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.
- P. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- Q. Install pull wires in empty pathways. 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 pathways designated as spare above grade alongside pathways in use.
- R. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:
  - 1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
  - 2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet
  - 3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.



- S. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- T. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
  - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where an underground service pathway enters a building or structure.
  - 3. Where otherwise required by NFPA 70.
- U. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.
- V. 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 temp. change.
    - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temp. 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.
- W. Flexible Conduit Connections: Comply with NEMA RV 3. Use 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.



- X. 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.
  - Y. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
  - Z. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
  - AA. 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.
  - BB. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
  - CC. Set metal floor boxes level and flush with finished floor surface.
  - DD. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- 3.03 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS
- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in
- 3.04 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 84 00 "Firestopping."
- 3.05 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



## SECTION 28 31 11

### DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

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

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. Manual fire-alarm boxes.
  - 3. System smoke detectors.
  - 4. Heat detectors.
  - 5. Notification appliances.
  - 6. Magnetic door holders.
  - 7. Addressable interface devices.
  - 8. Smoke detectors.
  - 9. Carbon monoxide detectors.
  - 10. Combustible gas detectors.

##### 1.03 DEFINITIONS

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.
- E. PC: Personal computer.
- F. VESDA: Very Early Smoke-Detection Apparatus.

##### 1.04 SUBMITTALS

- A. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, details, and attachments to other work.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.



4. Detail assembly and support requirements.
  5. Include voltage drop calculations for notification-appliance circuits.
  6. Include battery-size calculations.
  7. Include input/output matrix.
  8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
  9. Include performance parameters and installation details for each detector.
  10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  11. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring required for HVAC unit shutdown on alarm.
    - c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
    - d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
    - e. Locate detectors according to manufacturer's written recommendations.
    - f. Show air-sampling detector pipe routing.
  12. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
  2. Shop Drawings shall be prepared by persons with the following qualifications:
    - a. Trained and certified by manufacturer in fire-alarm system design.
    - b. NICET-certified, fire-alarm technician; Level III minimum.
    - c. Licensed or certified by authorities having jurisdiction.
- D. Qualification Data: For Installer.
- E. Field quality-control reports.
- F. Sample Warranty: For warranty.
- G. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
1. Include the following:
    - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.



- c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
- d. Riser diagram.
- e. Device addresses.
- f. Air-sampling system sample port locations and modeling program report showing layout meets performance criteria.
- g. Record copy of site-specific software.
- h. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
  - 1) Equipment tested.
  - 2) Frequency of testing of installed components.
  - 3) Frequency of inspection of installed components.
  - 4) Requirements and recommendations related to results of maintenance.
  - 5) Manufacturer's user training manuals.
- i. Manufacturer's required maintenance related to system warranty requirements.
- j. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

H. Software and Firmware Operational Documentation:

- 1. Software operating and upgrade manuals.
- 2. Program Software Backup: On magnetic media or compact disk, complete with data files.
- 3. Device address list.
- 4. Printout of software application and graphic screens.

1.05 MAINTENANCE MATERIAL

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

- 1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
- 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
- 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
- 5. Keys and Tools: One extra set for access to locked or tamper-proofed components.
- 6. Audible and Visual Notification Appliances: One of each type installed.
- 7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.
- 8. Filters for Air-Sampling Detectors: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.



## 1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

## 1.07 PROJECT CONDITIONS

- A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

## 1.08 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

# PART 2 - PRODUCTS

## 2.01 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Smoke detectors.
  - 4. Duct smoke detectors.
  - 5. Combination Smoke/Carbon monoxide detectors.
  - 6. Combustible gas detectors.





- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances.
  2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Unlock electric door locks in designated egress paths.
  5. Release fire and smoke doors held open by magnetic door holders.
  6. Activate voice/alarm communication system.
  7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  8. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  9. Activate emergency shutoffs for gas and fuel supplies.
  10. Record events in the system memory.
  11. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Alert and Action signals of air-sampling detector system.
  2. User disabling of zones or individual devices.
  3. Loss of communication with any panel on the network.
- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  4. Loss of primary power at fire-alarm control unit.
  5. Ground or a single break in internal circuits of fire-alarm control unit.
  6. Abnormal ac voltage at fire-alarm control unit.
  7. Break in standby battery circuitry.
  8. Failure of battery charging.
  9. Abnormal position of any switch at fire-alarm control unit or annunciator.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
  2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Record the event on system printer.
  4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
  5. Transmit system status to building management system.
  6. Display system status on graphic annunciator.



## 2.03 FIRE-ALARM CONTROL UNIT

- A. Manufacturers: Subject to compliance with requirements, provide products by the existing fire alarm system manufacturer.
- B. General Requirements for Fire-Alarm Control Unit:
  - 1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
    - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    - d. The FACP shall be listed for connection to a central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
  - 2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
  - 3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.
  - 1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
  - 2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
  - 1. Pathway Class Designations: NFPA 72, Class A.
  - 2. Pathway Survivability: Level 1.
  - 3. Install no more than 100 addressable devices on each signaling-line circuit.
  - 4. Serial Interfaces:
    - a. One dedicated RS 485 port for central-station operation using point ID DACT.
    - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
    - c. One RS 232 port for PC configuration.
- E. Smoke-Alarm Verification:
  - 1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
  - 2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.



3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

J. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory and digital alarm communicator transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

K. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Sealed lead calcium.

L. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

## 2.04 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.



3. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
4. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

## 2.05 SYSTEM SMOKE DETECTORS

- A. General Requirements for System Smoke Detectors:
  1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall be four-wire type.
  3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
  4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
  5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  6. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    - c. Multiple levels of detection sensitivity for each sensor.
    - d. Sensitivity levels based on time of day.
- B. Photoelectric Smoke and Combination Carbon Monoxide/Smoke Detectors:
  1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
- C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
  1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.



2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## 2.06 HEAT DETECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. General Requirements for Heat Detectors: Comply with UL 521.
  1. Temperature sensors shall test for and communicate the sensitivity range of the device.
- C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
  1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
- D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.
  1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
  2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

## 2.07 COMBUSTIBLE GAS DETECTOR

- A. Manufacturers: Macurco or approved equal.

## 2.08 NOTIFICATION APPLIANCES

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.



- C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
  - 1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
- D. Chimes, Low-Level Output: Vibrating type, 75-dBA minimum rated output.
- E. Chimes, High-Level Output: Vibrating type, 81-dBA minimum rated output.
- F. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.
- G. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- high letters on the lens.
  - 1. Rated Light Output:
    - a. 15/30/75/110 cd, selectable in the field.
  - 2. Mounting: Wall mounted unless otherwise indicated.
  - 3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
  - 4. Flashing shall be in a temporal pattern, synchronized with other units.
  - 5. Strobe Leads: Factory connected to screw terminals.
  - 6. Mounting Faceplate: Factory finished, red.
- H. Voice/Tone Notification Appliances:
  - 1. Comply with UL 1480.
  - 2. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
  - 3. High-Range Units: Rated 2 to 15 W.
  - 4. Low-Range Units: Rated 1 to 2 W.
  - 5. Mounting: Flush.
  - 6. Matching Transformers: Tap range matched to acoustical environment of speaker location.
- I. Exit Marking Audible Notification Appliance:
  - 1. Exit marking audible notification appliances shall meet the audibility requirements in NFPA 72.
  - 2. Provide exit marking audible notification appliances at the entrance to all building exits.
  - 3. Provide exit marking audible notification appliances at the entrance to areas of refuge with audible signals distinct from those used for building exit marking.



## 2.09 MAGNETIC DOOR HOLDERS

- A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
  - 1. Electromagnets: Require no more than 3 W to develop 25-lbf holding force.
  - 2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
  - 3. Rating: 24-V ac or dc.
  - 4. Rating: 120-V ac.
- B. Material and Finish: Match door hardware.

## 2.10 ADDRESSABLE INTERFACE DEVICE

- A. General:
  - 1. Include address-setting means on the module.
  - 2. Store an internal identifying code for control panel use to identify the module type.
  - 3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Control Module:
  - 1. Operate notification devices.
  - 2. Operate solenoids for use in sprinkler service.

## 2.11 NETWORK COMMUNICATIONS

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet for connection to building automation system.

# PART 3 - EXECUTION

## 3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.



### 3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.
  - 3. Expand, modify, and supplement existing control equipment as necessary to extend existing control functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.
- D. Manual Fire-Alarm Boxes:
  - 1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
  - 2. Mount manual fire-alarm box on a background of a contrasting color.
  - 3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- E. Smoke- or Heat-Detector Spacing:
  - 1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
  - 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
  - 3. Smooth ceiling spacing shall not exceed 30 feet.
  - 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
  - 6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.





- F. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- G. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
  - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- H. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
- I. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.
- J. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- K. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.
- M. Device Location-Indicating Lights: Locate in public space near the device they monitor.

### 3.03 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 08 71 00 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC duct systems.
  - 4. Magnetically held-open doors.



5. Electronically locked doors and access gates.
6. Alarm-initiating connection to elevator recall system and components.
7. Alarm-initiating connection to activate emergency lighting control.
8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
9. Supervisory connections at valve supervisory switches.
10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
11. Supervisory connections at elevator shunt-trip breaker.
12. Data communication circuits for connection to building management system.
13. Data communication circuits for connection to mass notification system.
14. Supervisory connections at fire-extinguisher locations.
15. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
16. Supervisory connections at fire-pump engine control panel.

### 3.04 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 05 53 "Identification for Electrical Systems"
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.05 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.06 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  4. Test audible appliances for the private operating mode according to manufacturer's written instructions.



5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- B. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
  - C. Fire-alarm system will be considered defective if it does not pass tests and inspections.
  - D. Prepare test and inspection reports.
  - E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
  - F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### 3.07 MAINTENANCE SERVICE

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
  1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

### 3.08 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.



### 3.09 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION



## SECTION 31 22 13

### ROUGH GRADING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Removal of topsoil and subsoil. Stockpile for later reuse. If material is suitable for re-use as directed by Designer, Contractor should re-use as fill material as needed. Excess material shall be removed from site; and the Contractor is to document final destination and quantity of material.
- B. Completion of rough grading.
- C. Grading and rough contouring the site.

##### 1.2 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing.
- B. Section 31 23 16 – Excavation.
- C. Section 31 23 23 – Backfill.
- D. Section 32 91 19 - Landscape Grading.

##### 1.3 REFERENCES

- A. ANSI/ASTM D698 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 5.5 lb (2.49 Kg) Rammer and 12-inch (304.8 mm) Drop.
- B. ANSI/ASTM D1556 - Test Method for Density of Soil in Place by the Sand-cone Method.
- C. ANSI/ASTM D1557 - Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10 lb (4.54 Kg) Rammer and 18-inch (457 mm) Drop.
- D. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.

##### 1.4 SUBMITTALS

- A. Samples: Submit 10 lb. sample of each type of fill material to be used to testing laboratory, in air-tight containers.
- B. Accurately record actual locations of utilities remaining, by horizontal dimensions, elevations or inverts, and slope gradients.



## 1.5 SITE CONDITIONS

- A. It is the intent of this item for the Contractor to perform whatever rough grading may be required to complete construction of the roadway and installation of the box culvert.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Topsoil: Excavated material, graded, free of roots, rocks larger than 1 inch, subsoil, debris, and large weeds.
- B. Subsoil: Excavated material, graded, free of lumps larger than 6 inches, rocks larger than 3 inches, and debris.

## PART 3 - EXCAVATION

### 3.1 EXAMINATION

- A. Verify site conditions under provisions of Section 31 10 00 – Site Clearing.
- B. Verify that survey benchmark and intended elevations for the Work are as indicated.

### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- C. Notify the utility company to remove and relocate utilities if required.
- D. Protect areas above subsurface utilities which are to remain.
- E. Upon discovery of unknown utility or concealed conditions, discontinue affected Work. Notify Designer.
- F. Protect plant life and other features remaining as a portion of final landscaping.
- G. Protect bench marks, existing features to remain including structures, and fences from excavation equipment and vehicular traffic.

### 3.3 TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated.
- B. Stockpile in Owner designated area on site. Contractor to coordinate stockpile location with Owner. Cover to protect from erosion. Remove excess topsoil not being reused, from site.
- C. Do not excavate wet topsoil.



### 3.4 SUBSOIL EXCAVATION

- A. Excavate subsoil from areas to be further excavated, landscaped, or re-graded.
- B. Stockpile in Owner designated area on site. Contractor to coordinate stockpile location with Owner. Remove excess subsoil not being reused, from site.
- C. Do not excavate wet subsoil, dewater prior to excavation.
- D. Stockpile subsoil to depth not exceeding 8 feet. Cover to protect from erosion.
- E. When excavation through roots is necessary, perform work by hand and cut roots with sharp axe.

### 3.5 FILLING

- A. Fill areas to contours and elevations in accordance with plans with unfrozen materials.
- B. Granular Fill: Place and compact materials in continuous layers not exceeding 8 inches compacted depth, compacted to 95 percent.
- C. Subsoil Fill: Place and compact material in continuous layers not exceeding 8 inches compacted depth, compacted to 95 percent.
- D. Maintain optimum moisture content of fill materials to attain required compaction density.
- E. Slope grade away from building minimum 6 inches in 10 feet unless noted otherwise.
- F. Make grade changes gradual. Blend slope into level areas.
- G. Remove surplus fill materials from site.

### 3.6 TOLERANCES

- A. Top Surface of Subgrade: Plus or minus one inch.

### 3.7 FIELD QUALITY CONTROL FOR FILL MATERIAL

- A. Field inspection and testing will be performed under provisions BY Owner or the assigns.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D1557, ANSI/ASTM D2922, Section 31 23 23 – Backfill.
- C. If tests indicate Work does not meet specified requirements, set forth in Section 31 23 23 - Backfill, remove Work, replace and retest at no cost to Owner. Frequency of Tests: Under provisions of Section 31 23 23 - backfill.
- D. Contractor shall provide copies of all test results to the Designer within 2 business days of completion of the test.

END OF SECTION



## SECTION 31 23 16

### EXCAVATION

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Excavation for site structures.

##### 1.2 RELATED SECTIONS

- A. Section 31 10 00 - Site Clearing.
- B. Section 31 23 23 - Backfill.

##### 1.3 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as indicated.

#### PART 2 - EXECUTION

##### 2.1 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground and aerial utilities. Stake and flag locations.
- C. Erect sheeting, shoring, and bracing as necessary for protection of persons, improvements, and excavations and as indicated on the Drawings in accordance with applicable OSHA requirements.
- D. Provide dewatering and drainage as required to accomplish work of this section.
- E. Protect new construction, existing structures, existing utilities, plants, trees, etc. at all times. Report any damages immediately to Designer and proper authorities.
- F. Use extreme caution when excavating near underground utilities. Employ manual excavation where necessary.
- G. Inform appropriate utility or agency of all actions in vicinity of underground pipes, mains, conducts, wires, etc. Coordinate all work with appropriate utility or agency and comply with all requirements.





## 2.2 EXCAVATION

- A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
- B. Excavate subsoil required to accommodate site structures.
- C. Machine slope banks to angle of repose or less, until shored.
- D. Excavate all materials regardless of nature of elevations and dimensions indicated plus sufficient space for forming, shoring, draining, inspection, etc. Excavate using open cut method unless otherwise indicated or permitted.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Hand trim excavation. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock up to two cubic yards measured by volume.
- H. Allow Designer to inspect bottom of excavation for suitability of base material.
- I. Remove unsuitable base material to a depth of at least 12 inches below any pipe or structure or to a depth directed by the Engineer and replace with compacted screened gravel or crushed stone or provide proper base as otherwise directed by Engineer. Place no footing, wall, structure, pipe, etc. on unsuitable material.
- J. Place no structure, pipe, etc. partially on earth and partially on rock. Remove rock and replace with compacted screened gravel or crushed stone in accordance with Section 31 23 23 – Backfill.
- K. Protect excavation bottoms from frost and weathering. Place no structure, pipe, etc. on frozen or weathered ground.
- L. Notify Designer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- M. Correct unauthorized excavation at no extra cost to Owner.
- N. Correct areas over-excavated by error in accordance with Section 31 23 23 - Backfill.
- O. Stockpile excavated material in area designated on site and remove excess material not being reused, from site. Document the final destination of all refuse material.



## 2.3 FIELD QUALITY CONTROL OF EXCAVATIONS

- A. Field inspection will be performed by the Contractor under provisions of this section to ensure excavation is safe for work. Contractor must provide Designer with copies of field notes upon request.
- B. Contractor and Field Inspector to provide for visual inspection of bearing surfaces.

## 2.4 PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.

END OF SECTION



## SECTION 31 23 17

### TRENCHING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Excavation of trenches for utilities.
- B. Bedding and backfilling of utilities.
- C. Compaction of bedding and backfill material over utilities to subgrade elevations.

##### 1.2 RELATED SECTIONS

- A. Section 31 23 16 – Excavation.

##### 1.3 REFERENCES

- A. ANSI/ASTM C136 – Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1557 – Modified Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures, Using 10 lb Rammer and 18-inch Drop.

##### 1.4 FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the Work are as shown on drawings.

#### PART 2 - PRODUCTS

##### 2.1 FILL MATERIALS

- A. Types as specified in Section 31 23 23.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Verify fill materials to be reused, are acceptable and obtain Engineer's approval.

##### 3.2 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Maintain and protect existing utilities remaining, which pass through work area.
- C. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.



- D. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- E. Protect above and below grade utilities which are to remain.
- F. Cut out soft areas of subgrade not capable of in situ compaction. Backfill with approved granular material and compact to density equal to or greater than requirements for subsequent backfill material.
- G. Cut pavement using masonry saw, pavement breaker, or other appropriate device to provide a uniform edge and to minimize damage to remaining pavement. Do not use removed pavement as fill.

### 3.3 EXCAVATION

- A. Excavate subsoil required for water service installation, culverts, sanitary sewers, storm sewers, underground conduits, and precast light bases.
- B. Cut trenches sufficiently wide to enable installation of utilities and allow inspection.
- C. Excavation shall not interfere with normal 45 degree bearing splay of foundations.
- D. Hand trim excavation. Hand trim for bell and spigot pipe joints. Remove loose matter.
- E. Remove lumped subsoil, boulders, and rock up to two cubic yards, measured by volume.
- F. Correct unauthorized excavation at no cost to Owner.
- G. Correct areas over-excavated by error in accordance with Section 31 23 23.
- H. Stockpile excavated material in area designated on site and provide proper erosion control measures. Excess material shall be removed off site and disposed of properly.

### 3.4 BEDDING

- A. Support pipe and conduit during placement of crushed stone or specified bedding material.
- B. Do not compact crushed stone over any flexible plastic pipe.
- C. Bedding material thickness shall be in accordance with the Contract Drawings.

### 3.5 BACKFILLING

- A. Backfill trenches to contours and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.



- C. Granular Fill: Place and compact materials in continuous layers not exceeding six inches compacted depth.
- D. Soil Fill: Place and compact material in continuous layers not exceeding eight inches compacted depth.
- E. Employ a placement method that does not disturb or damage pipe in trench.
- F. Maintain optimum moisture content of fill materials to attain required compaction density.
- G. Surplus fill materials shall be removed off site.
- H. Fill material stockpile areas shall be compiled neatly and provided proper erosion control protection.

### 3.6 TOLERANCES

- A. Top Surface of Backfilling: Under Paved Areas plus or minus one half inch from required elevations.
- B. Top Surface of General Backfilling: Plus or minus one inch from required elevations.

### 3.7 FIELD QUALITY CONTROL

- A. Field testing will be performed under provisions of Section 01 40 00.
- B. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D1557 and Section 01 40 00.
- C. Compaction testing will be performed in accordance with ANSI/ASTM D6938 and with Section 01 40 00.
- D. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest at no cost to Owner.

### 3.8 PROTECTION OF FINISHED WORK

- A. Protect finished Work under provisions of Section 01 50 00.

END OF SECTION



## SECTION 31 23 23

### BACKFILL

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Site filling and backfilling.
- B. Fill, aggregate subbase, and aggregate base under paving.
- C. Consolidation and compaction.
- D. Fill for over-excavation.

##### 1.2 RELATED SECTION

- A. Section 31 23 16 - Excavation.
- B. Section 32 91 19- Landscape Grading.

##### 1.3 REFERENCES

- A. ANSI/ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates.
- B. ANSI/ASTM D1557 – Modified Test Method for Moisture Density Relations of Soils and Soil Aggregate Mixtures, Using 10 lb Rammer and 18 inch Drop.
- C. ASTM D6938 – Standard Test Method for In-Place Density and water content of soil and soil aggregate by Nuclear Methods (Shallow Depth).
- D. ASTM D2487 - Classification of Soils for Engineering Purposes.
- E. ASTM 4318 - Test Method For Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
- F. ASTM D1140 - Test Method For Amount of Material in Soils Finer than the No. 200 (75 -µm) sieve.

#### PART 2 - PRODUCTS

##### 2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENT

- A. General: Fill, backfill, and embankment materials shall be suitable selected or processed clean, fine earth, rock or sand, free from grass, roots, brush, or other vegetation.
- B. Fill and backfill to be placed within 6 inches of any structure or pipe shall be free of rocks or unbroken masses of earth materials having a maximum dimension no larger than 3 inches for structures, and 1 inch for DI, PVC and HDPE pipe.



- C. Suitable Materials: Soils not classified as unsuitable as defined in paragraph entitled, "Unsuitable Material" herein, are defined as suitable material and may be used in fills, backfilling, and embankment construction subject to approval by Engineer, some of the material listed as unsuitable may be used when thoroughly mixed with suitable material to form a stable composite.
- D. Suitable materials may be obtained from on-site excavations, may be processed on-site materials, or may be imported. If imported materials are required to meet the requirements of the section or to meet the quantity requirements of the project, the Contractor shall provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule.
- E. The following types of suitable materials are designated and defined as follows:

- 1. COMMON BORROW

Common borrow shall consist of earth, suitable for embankment construction. It shall be free from frozen material, perishable rubbish, peat, and other unsuitable material.

The moisture content shall be sufficient to provide the required compaction and stable embankment. In no case shall the moisture content exceed 4 percent above optimum.

The optimum moisture content shall be determined in accordance with ASTM D1557.

- 2. CRUSHED STONE/BEDDING MATERIAL

Crushed stone shall be durable crushed rock consisting of the angular fragments obtained by breaking and crushing solid or shattered natural rock and reasonably free from thin, flat, elongated, or other objectionable pieces. The crushed stone shall be reasonably free from sand, clay, loam, chemical decay, or deleterious materials and not more than one percent of material passing a No. 200 sieve will be allowed to adhere to the crushed stone.

The crushed stone shall be uniformly blended according to the grading requirements listed in the following table:

3/4 inch crushed stone:

<u>Sieve Size</u>	<u>Weight Passing (%)</u>
1"	100
3/4"	95-100
1/2"	35-70
3/8"	0-25

1½ inch crushed stone:



<u>Sieve Size</u>	<u>Weight Passing (%)</u>
2"	100
1"	0-60
3/4"	0-30
1/2"	0-15
3/8"	0-25

### 3. SAND

Sand shall be well graded coarse sand without excessive fines and free from loam, clay, and organic matter. Beach sand shall not be used. The grading requirements are as follows:

<u>Sieve Size</u>	<u>Weight Passing (%)</u>
3/8"	100
No. 4	95-100
No. 16	50- 85
No. 50	0-30
No. 100	2-10

### 4. AGGREGATE SUBBASE

Aggregate subbase shall be sand or gravel consisting of hard durable particles which are free from vegetable matter, lumps, or balls of clay, and other deleterious substances. The gradation of the portion which will pass a 3 inch sieve shall meet the grading requirements of the following table:

<u>Sieve Size</u>	<u>Weight Passing (%)</u>
1/4"	25-70
No. 40	0-30
No. 200	0-7

Granular subbase and gravel subbase shall not contain particles of rock which will not pass the 6-inch square mesh sieve.

Gradation tests shall conform to ASTM C136 except that the material may be separated on the 1/2 inch sieve.

### 5. AGGREGATE BASE

Aggregate Base shall be screened or crushed gravel consisting of hard durable particles which are free from vegetable matter, lumps or balls of clay, and other deleterious substances.

The gradation shall meet the grading requirements of the following table:





<u>Sieve Size</u>	<u>Weight Passing (%)</u>
1/2"	45-70
1/4"	30-55
No. 40	0-20
No. 200	0-5

Screened or crushed gravel base shall not contain particles or rock which will not pass the 2-inch square mesh sieve.

Gradation tests shall conform to ASTM C136 except that the material may be separated on the ½ inch sieve.

#### 6. STRUCTURAL FILL AND BACKFILL

Structural fill shall be a material free from organic matter, frozen material and other deleterious substances. Maximum particle size should not exceed two-thirds of the proposed loose lift thickness. All fill will be compacted to at least 95% of its a maximum dry density as determined by ASTM D-6938.

Fill placed adjacent to foundations as backfill will be a clean granular material meeting the gradation requirements of the following table.

<u>Sieve Size</u>	<u>Weight Passing (%)</u>
4"	100
3"	90-100
1/4"	25-90
#40	0-30
#200	0-5

#### 7. REFILL MATERIAL

Refill material for replacement of unsuitable material or rock excavation below grade shall be aggregate subbase material or crushed stone of 3/4 inch maximum size, free from silt, loam, and clay.

#### 8. BEDDING MATERIAL

Where any of the above material is to be used for bedding materials, it shall further meet the following additional criteria. Bedding material shall be so graded that 100% will pass a one (1) inch screen and not more than 10% will pass a 200-mesh sieve. Gradation test results of the bedding material shall be submitted to the Engineer for approval. In the event abnormally unstable or wet conditions are encountered, bedding material shall be crushed stone, if directed by the Engineer.



## 2.2 UNSUITABLE MATERIAL

- A. Unsuitable soils for fill and backfill material shall include soils which, when classified under the standard method for "Classification of Soils for Engineering Purposes"(ASTM D2487), fall in the classifications of Pt, OH, CH, MH, or OL.
- B. In addition, any soil containing organic matter, having a plastic limit of less than 8 percent when tested in accordance with the requirements of ASTM D4318 and containing more than 25 percent of material, by weight, passing the No. 200 sieve when analyzed according to the requirements of ANSI/ASTM D1140, or any soil which cannot be compacted sufficiently to achieve the percentage of maximum density specified for the intended use, shall be classed as unsuitable material.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify fill materials to be reused are acceptable.

### 3.2 PREPARATION

- A. Scarify and recompact subgrade to density required for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of insitu compaction. Backfill with approved granular material and compact to a density equal to or greater than requirements for subsequent backfill material.

### 3.3 BACKFILLING

- A. Use suitable materials from excavations which conform to the requirements herein or are approved by the Designer for backfill up to rough grade lines except where these specifications have more stringent or special requirements for certain parts of the contract work. Supply extra fill if there is not enough fill to complete the project. Use no material from any excavation as backfill unless approved by the Designer.
- B. Material within two feet of finished grade in any areas within five feet horizontally of any structure shall contain no stone having any dimension exceeding six inches. Excess and unsuitable excavated materials shall be stock piled onsite at the Owners discretion. In the event sufficient suitable excavated material is not available for backfill, supply a granular backfill.
- C. Place materials in layers of thicknesses specified herein but in no case greater than 12 inches before compaction. Wet backfill uniformly, when necessary, to obtain required density. Compact each layer with vibratory compactors before placing next layer.
- D. In cross-country runs, trenches shall be backfilled and mounded six inches above surrounding grade in addition to the normal compaction procedure.



- E. In backfilling around structures, place material in 8 inch layers and then compact. Allow no heavy machinery within 5 feet of structure during placement. Place no material until structure can withstand the load. Place temporary backfill where required and remove when no longer required. Bring backfill up evenly on all sides of the structure.
- F. Systematically backfill to allow maximum time for natural settlement. Do not backfill overporous, wet, frozen, or spongy subgrade surfaces.
- G. Maintain moisture content within 2 percent, plus or minus, of optimum moisture content of backfill materials to attain required compaction density.

### 3.4 FIELD QUALITY CONTROL

- A. Tests and analysis of fill material will be performed in accordance with ANSI/ASTM D1557, ANSI/ASTM D136.
- B. Compaction testing will be performed in accordance with ANSI/ASTM D6938.
- C. If tests indicate Work does not meet specified requirements per Designer, remove Work, replace, and retest at no cost to Owner.
- D. Frequency of Tests: Compaction Tests -
  - 1. Trench - 1 test every 300 feet or each culvert, each lift.
  - 2. Site Work / Roads - 1 test every 5,000 S.F., each lift, unless otherwise stated.
- E. Minimum densities following compaction shall be as follows:

<u>Fill and Backfill Location</u>	<u>Modified Proctor Density %</u>
Under or within five feet of structures	95
Fill For Erosion Repair Areas	92
Trenches through unpaved areas	92
In embankment (including temporary)	92
Pipe bedding and trenching	92

- F. Compaction shall be accomplished by appropriate methods, i.e., vibratory compaction of granular materials, sheepsfoot compaction of cohesive materials, etc. In no case shall trench compaction be deemed adequate with the use of a non-compactive device such as a bulldozer.

The Designer may withhold 5 percent of the monthly requisition if in his opinion proper compaction was not met. Improperly compacted materials shall be removed, replaced, or recompacted.

### 3.5 PROTECTION OF FINISHED WORK

- A. Recompect fills subjected to vehicular traffic.

END OF SECTION



## SECTION 31 25 13

### EROSION CONTROLS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Site preparation.
- B. Remove surface debris, clear site of plant life and grass.
- C. Remove trees and shrubs, including root systems.
- D. Install and maintain silt fencing, erosion control blanket, and other erosion control measures.

##### 1.2 RELATED SECTIONS

- A. Section 31 10 00 – Site Clearing.
- B. Section 31 23 16 - Excavation

##### 1.3 REGULATORY REQUIREMENTS

- A. Conform to applicable codes and regulations for environmental requirements and disposal of debris.
- B. Conform to “Maine Erosion and Sediment Best Management Practices, March 2003 (revised 10/2012), hereinafter referred to as “Maine BMP Manual”.
- C. Coordinate clearing Work with Owner.

##### 1.4 SITE CONDITIONS

- A. The intent of this item is for the Contractor to complete any site preparation work needed for the project.

#### PART 2 - PRODUCTS

##### 2.1 MATERIALS

- A. Silt Fence: Mirafi Silt Fence or approved equal. Standard strength, permeability of 0.3 gal/sq ft/min.
- B. Erosion Control Geotextile: Mirafi 160N blanket or approved equal rated for 10 fps.
- C. Slope Stabilization Mesh/Blanket: North American Green SC150 or approved equal



- D. Inlet Protection: SiltSack or approved equal.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify that existing plant life and features designated to remain are tagged or identified.

### 3.2 PROTECTION

- A. Locate, identify and protect utilities that remain from damage.
- B. Protect trees, plant growth, and features designated to remain as final landscaping.
- C. Protect bench marks and existing structures from damage or displacement.

### 3.3 CLEARING

- A. Clear areas required for access to site and execution of Work.
- B. Remove trees and shrubs within areas indicated. Remove stumps, main root ball, root system and surface rock to a depth of 12 inches.

### 3.4 INSTALLATION OF EROSION CONTROL MEASURES

- A. Silt Fence:
  - 1. Install silt fence in accordance with Maine BMP Manual.
  - 2. Install silt fence at bottom of all fill slopes and downstream edge of disturbed soil areas.
  - 3. Install silt fence at constant elevation.
- B. Silt Sock:
  - 1. Install Silt Sock in accordance with the Maine BMP Manual.
  - 2. Install Silt Sock at bottom of all fill slopes and downstream edge of disturbed soil areas.
  - 3. Install Silt Sock at constant elevation.
- C. Check Dams: Install as required by the Maine BMP Manual.
- D. Erosion Control Blanket:
  - 1. Install erosion control blanket in accordance with manufacturers recommendation.
  - 2. Install erosion control blanket in the flow line of ditches as show in the project drawings.

END OF SECTION



## SECTION 31 38 00

### GEOTEXTILES

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Geotextile used as erosion control and for stabilization between fill materials.

##### 1.2 RELATED SECTIONS

- A. Section 31 23 16 - Excavation.
- B. Section 31 23 23 - Backfill.

##### 1.3 SUBMITTALS

- A. Product Data: Submit manufacturer design data, test reports, and installation instructions.

##### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Storage and Protection: Material to be wrapped in heavy duty protective covering during shipment, storage, and prior to installation.

##### 1.5 SITE CONDITIONS

- A. Verify that site is prepared to receive geotextile.

#### PART 2 PRODUCTS

##### 2.1 MANUFACTURERS

- A. Geotextile:
  - 1. Erosion Geotextile: Mirafi 160N, or approved equal
  - 2. Roadway Geotextile: Mirafi 600X, or approved equal

##### 2.2 MATERIALS

- A. Geotextile properties: Mirafi 160N
- B. Geotextile properties: Mirafi 600X

#### PART 3 EXECUTION

##### 3.1 EXAMINATION

- A. Site Verification of Conditions: Verify that site is ready to receive geotextile.



### 3.2 PREPARATION

- A. Surface Preparation: Maintain surface free of stones or projections that may damage geotextile.

### 3.3 INSTALLATION

- A. Install in accordance with manufacturer recommendations.
- B. Install in maximum practical widths and lengths, with minimum of seams and joints.
- C. Provide full coverage over area where required in accordance with the drawings.

### 3.4 SCHEDULE

- A. Mirafi 160N: Under all riprap
- B. Mirafi 600X: Separation between Subbase Gravel and subgrade.

### 3.5 FIELD QUALITY CONTROL

- A. Inspection: Allow Designer to inspect installation prior to placement of any backfill or riprap.
- B. Repair or replace any areas found to be unsatisfactory.

### 3.6 PROTECTION

- A. Protect geotextile from damage prior to placement of subsequent materials.

END OF SECTION



## SECTION 32 12 16

### ASPHALTIC PAVING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Asphaltic concrete paving.
- B. Temporary Asphalt Patching

##### 1.2 RELATED SECTIONS

- A. Section 31 23 23 - Backfilling.
- B. Section 31 91 19 - Landscape Grading.

##### 1.3 REFERENCES

- A. Maine Department of Transportation Standard Specifications Highways and Bridges, current edition.

##### 1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with Maine Department of Transportation Standard Specification - Highway and Bridges.
- B. Mixing Plant: Conform to State of Maine Department of Transportation Standards.
- C. Obtain materials from same source throughout.

##### 1.5 REGULATORY REQUIREMENTS

- A. Conform to applicable standards for paving work on public property.

##### 1.6 ENVIRONMENTAL REQUIREMENTS

- A. Do not place asphalt when base surface temperature is less than 40 degrees F, or surface is wet or frozen.
- B. Apply bituminous prime and tack coats only when the ambient temperature in the shade is at least 50°F for 12 hours immediately prior to application.
- C. Do not apply when the base surface is wet or contains an excess of moisture which would prevent uniform distribution and the required penetration.





## PART 2 - PRODUCTS

### 2.1 AGGREGATE SUBBASE

- A. As specified in Section 31 23 23 - Backfill.

### 2.2 BITUMINOUS CONCRETE BASE COURSE

- A. MDOT Specification, Section 702 and 703.
- B. 19.0 mm Binder.

### 2.3 BITUMINOUS TACK COAT

- A. MDOT Specification, Section 702.
- B. Type AE-90, Emulsified Asphalt, Mixing.

### 2.4 BITUMINOUS CONCRETE SURFACE COURSE

- A. MDOT Specification, Sections 702 and 703.
- B. 12.5 mm.

### 2.5 TEMPORARY PATCHING

- A. UPM ® Cold Mix – Permanent Pavement Repair Material and Asphalt Patch
  - 1. By Unique Paving Materials Corp.  
(<https://www.uniquepavingmaterials.com/asphalt-repair/upm-cold-mix/>)
  - 2. Available through Sargent Corporation – Asphalt operations, Hermon, ME

### 2.6 ACCESSORIES

- A. Tack Coat: Homogeneous, medium curing, liquid asphalt, in accordance with State of Maine Specifications.

## PART 3 - EXECUTION

### 3.1 AGGREGATE SUBBASE

- A. As specified in Section 31 23 23 - Backfill.

### 3.2 BITUMINOUS CONCRETE BASE COURSE

- A. MDOT Specification, Section 403.



### 3.3 BITUMINOUS TACK COAT

- A. Apply emulsified asphalt tack coat between all lifts, to curbing, gutters, manholes, pavement, etc. to promote adequate bond.
- B. Apply at a rate of 0.05 to 0.15 gallons/square yard; excess coating and/or fat spots will not be permitted.

### 3.4 BITUMINOUS CONCRETE SURFACE COURSE

- A. MDOT Specification, Section 403.

### 3.5 COMPACTION

- A. Bituminous compaction shall take place at as high a temperature as possible without the mix bulging excessively in front of the rolls. For most dense graded mixes this is between 260° F and 285° F. At no time shall the pavement be allowed to fall below 175° F without compaction. Table 1, at the end of this Section, illustrates recommended laydown temperatures for various mix thickness giving 15 minutes until 175° F mat temperature is reached.
- B. Pavement compacted at temperatures below 175° may be removed if specified by the Engineer.

### 3.6 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/4 inch.
- C. Variation from True Elevation: Within 1/2 inch.

### 3.7 FIELD QUALITY CONTROL

- A. Field testing will be performed under provisions of Section 01 40 00.

### 3.8 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 3 days.

### 3.9 SCHEDULES

- A. Roadway: 4" of total depth
  - 1. Base Course: 2.5" of 19.0mm HMA
  - 2. Surface Course: 1.5" of 9.5mm HMA



- B. Conform to MDOT requirements for minimum laydown temperature and cessation requirements.

TABLE 1  
CESSATION REQUIREMENTS  
Recommended Minimum Laydown Temperature

<b><u>Base Temp.</u></b>	<b><u>½"</u></b>	<b><u>¾"</u></b>	<b><u>1"</u></b>	<b><u>1½"</u></b>	<b><u>2"</u></b>	<b><u>3"and Greater</u></b>
20 - 32	---	---	---	---	---	285 <sup>1</sup>
+32 - 40	---	---	---	305	295	280
+40 - 50	---	---	310	300	285	275
+50 - 60	---	310	300	295	280	270
+60 - 70	310	300	290	285	275	265
+70 - 80	300	290	285	280	270	265
+80 - 90	290	280	275	270	265	260
+90	280	275	270	265	260	255
Rolling Time, Minutes	4	6	8	12	15	15

<sup>1</sup> Increase by 15° when placement is on base or subbase containing frozen moisture.

END OF SECTION



## SECTION 32 17 23

### PAINTED PAVEMENT MARKINGS

#### PART 1 GENERAL

##### 1.1 SECTION INCLUDES

- A. Traffic lines and markings.
- B. Paint.

##### 1.2 RELATED SECTIONS

- A. Section 32 12 16 - Asphaltic Concrete Pavement

##### 1.3 REFERENCES

- A. ASTM International:
  - 1. ASTM D34 - Standard Guide for Chemical Analysis of White Pigments.
  - 2. ASTM D562 - Standard Test Method for Consistency of Paints Using the Stormer Viscometer.
  - 3. ASTM D969 - Standard Test Method for Laboratory Determination of Degree of Bleeding of Traffic Paint.
  - 4. ASTM D1394 - Standard Test Methods for Chemical Analysis of White Titanium Pigments.
  - 5. ASTM D1640 - Standard Test Methods for Drying, Curing, or Film Formation of Organic Coatings at Room Temperature.
  - 6. ASTM D2202 - Standard Test Method for Slump of Sealants.
  - 7. ASTM D2371 - Standard Test Method for Pigment Content of Solvent-Reducible Paints.
  - 8. ASTM D2621 - Standard Test Method for Infrared Identification of Vehicle Solids From Solvent-Reducible Paints.
  - 9. ASTM D2743 - Standard Practices for Uniformity of Traffic Paint Vehicle Solids by Spectroscopy and Gas Chromatography.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Paint Adhesion: Adhere to road surface forming smooth continuous film one minute after application.
- B. Paint Drying: Tack free by touch so as not to require coning or other traffic control devices to prevent transfer by vehicle tires within two minutes after application.



## 1.5 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit paint formulation for each type of paint.
- C. Manufacturer's Installation Instructions: Submit instructions for application temperatures, eradication requirements, application rate, line thickness, type of glass beads, bead embedment and bead application rate, and any other data on proper installation.
- D. Manufacturer's Certificate: Certify Products meet or exceed specified requirements.

## 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with State of Maine Department of Transportation standards.

## 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Invert containers several days prior to use when paint has been stored more than 2 months. Minimize exposure to air when transferring paint. Seal drums and tanks when not in use.

## 1.9 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: Environmental conditions affecting products on site.
- B. Do not apply materials when surface and ambient temperatures are outside temperature ranges required by paint product manufacturer.
- C. Do not apply exterior coatings during rain or snow when relative humidity is outside humidity ranges, or moisture content of surfaces exceed those required by paint product manufacturer.
- D. Do not apply paint when temperatures are expected to fall below 50° F for 24 hours after application.



- E. Volatile Organic Content (VOC). Do not exceed State or Environmental Protection Agency maximum VOC on traffic paint.

#### 1.10 WARRANTY

- A. Section 01 70 00 - Closeout Procedure: Requirements for warranties.
- B. Furnish three-year manufacturer's warranty for traffic paints.

#### 1.11 MAINTENANCE SERVICE

- A. Section 01 70 00 - Closeout Procedure: Requirements for maintenance service.
- B. Furnish service and maintenance of traffic paints for three years from Date of Substantial Completion.

### PART 2 PRODUCTS

#### 2.1 PAINTED PAVEMENT MARKINGS

- A. Furnish materials in accordance with State of Maine Department of Transportation standards.
- B. Paint: Ready mixed, conventional and fast dry waterborne traffic paints, lead-free, non-toxic, NASSHTO Test Deck, minimum retroreflectance of 100 mcads, durability rating of 6 or more after in place for 9 months; within following limits:
  - 1. Pigment, percent by weight: 60 plus or minus 2.
  - 2. Vehicle, percent by weight: 40 plus or minus 2.
  - 3. Non-Volatile, percent by weight of paint: 76.0.
  - 4. Weight per gallon, pounds minimum 13.0.
  - 5. Viscosity: 80-95 Krebs Units at 77 degrees F.
  - 6. Grind (Hegeman Guage), minimum Field Tested no tracking time under ambient conditions: 20-90 seconds.
  - 7. Dry Through Time, 15 mils wet at 90 percent relative humidity, 72 degrees F, ASTM D1640: 125 minutes maximum.
  - 8. VOC (Volatile Organic Content): One lbs/gal maximum.
- C. Graded Glass Beads
  - 1. The material must contain a minimum of thirty percent (30%) intermixed graded glass beads by weight. The intermixed beads shall be clear and transparent. Not more than twenty percent (20%) consists of irregular fused spheroids, or silica. The index of refraction shall not be less than 1.50.
  - 2. The material must have factory applied coated surface beads and abrasives in addition to the intermixed beads at a rate of 1/2 lb. ( $\pm$  20%) per 11 sq. ft. The surface beads and abrasives must be applied in an alternating arrangement across the surface of the material so that the surface is covered in what is best described as a "checkerboard" pattern of glass beads and abrasive materials. The abrasive



material must have a minimum hardness of 8 (Mohs scale). These factory-applied coated surface beads shall have the following specifications:

- a. Minimum 80% rounds
- b. Minimum refractive index of 1.5
- c. Minimum SiO<sub>2</sub> Content of 70%
- d. Maximum iron content of 0.1%;

Size Gradation

US Mesh	Um	Retained, %	Passing, %
12	1700	0 - 2%	98 - 100%
14	1400	0 - 6%	94 - 100%
16	1180	1 - 21%	79 - 99%
18	1000	28 - 62%	38 - 72%
20	850	62 - 71%	29 - 38%
30	600	67 - 77%	23 - 33%
50	300	86 - 95%	5 - 14%
80	200	97-100%	0 - 3%

- D. Skid Resistance: The surface of the preformed retroreflective marking materials, wherein every other shaped portion contains glass beads, or abrasives with a minimum hardness of 8 (Mohs scale), shall upon application provide a minimum skid resistance value of 60 BPN when tested according to ASTM: E 303.
- E. Retroreflectivity: The preformed retroreflective marking materials upon application shall exhibit adequate and uniform nighttime retroreflectivity. The marking materials shall have the following retroreflectivity as measured using a Delta LTL 2000 or LTL-X Retroreflectometer: White preformed reflective marking materials—minimum of 275 mcd•m-2•lx-1
- F. Environmental Resistance: The material must be resistant to deterioration due to exposure to sunlight, water, salt or adverse weather conditions and impervious to oil and gasoline.

## 2.2 EQUIPMENT

### A Walk Behind Application Equipment:

- 1. For application of crosswalks, intersections, stop lines, legends and other miscellaneous items by walk behind stripers, hand spray or stencil trucks, apply with equipment meeting requirements of this section. Do not use hand brushes or rollers.

## 2.3 SOURCE QUALITY CONTROL

- A. Section 01 40 00 - Quality Control: Testing, inspection and analysis requirements.



## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Do not apply paint to concrete surfaces until concrete has cured for 28 days.

### 3.2 PREPARATION

- A. Maintenance and Protection of Traffic:
  - 1. Prevent interference with marking operations and to prevent traffic on newly applied markings before markings dry.
- B. Surface Preparation.
  - 1. Clean and dry paved surface prior to painting.
  - 2. Blow or sweep surface free of dirt, debris, oil, grease or gasoline.

### 3.3 APPLICATION

- A. Agitate paint for 1-15 minutes prior to application to ensure even distribution of paint pigment.
- B. Dispense paint at ambient temperature to wet-film thickness of 15 mils.
- C. Apply markings to indicated dimensions at indicated locations.
- D. Prevent splattering and over spray when applying markings.
- E. Unless material is track free at end of paint application convoy, use traffic cones to protect markings from traffic until track free. When A vehicle crosses a marking and tracks it or when splattering or over spray occurs, eradicate affected marking and resultant tracking and apply new markings.
- F. Collect and legally dispose of residues from painting operations.

### 3.4 APPLICATION TOLERANCES

- A. Section 01 40 00 - Quality Controls: Tolerances.
- B. Maximum Variation from Wet Film Thickness: 1 mil.
- C. Maximum Variation from Wet Paint Line Width: Plus or minus 1/8 inch.

### 3.5 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Controls: Field inspecting, testing, adjusting, and balancing.





- B. Inspect for incorrect location, insufficient thickness, line width, coverage, retention, uncured or discolored material, and insufficient bonding.
- C. Repair lines and markings, which after application and curing do not meet following criteria:
  - 1. Incorrect Location: Remove and replace incorrectly placed patterns.
  - 2. Insufficient Thickness, Line Width, Paint Coverage, Glass Bead Coverage or Retention: Prepare defective material by acceptably grinding or blast cleaning to remove a substantial amount of beads and to roughen marking surface. Remove loose particles and debris. Apply new markings on cleaned surface in accordance with this Section.
  - 3. Uncured or Discolored Material, Insufficient Bonding: Remove defective markings in accordance with this Section and clean pavement surface one foot beyond affected area. Apply new markings on cleaned surface in accordance with this Section.
- D. Replace defective pavement markings as specified throughout 1 year warranted period. Replace markings damaged by anti-skid materials, studded tires, tire chains, chemical deicers, snow plowing or other loss of marking material regardless of cause. When markings are damaged by pavement failure or by Owner's painting, crack sealing, or pavement repair operations, Contractor is released from warranty requirements for damaged work. Prepare list of defective areas and areas requiring additional inspection and evaluation to decide where material may need replaced. Provide traffic control as necessary if markings require more detailed evaluation.
- E. Replace pavement marking material under warranty using original or better type material.

### 3.6 PROTECTION OF FINISHED WORK

- A. Protect painted pavement markings from vehicular and pedestrian traffic until paint is dry and track free. Follow manufacturer's recommendations or use minimum of 30 minutes. Consider barrier cones as satisfactory protection for materials requiring more than 2 minutes dry time.

END OF SECTION



## SECTION 32 31 13

### CHAIN LINK FENCES AND GATES

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section includes all work associated with chain link fencing including:
  - 1. Temporary security fencing and gates
  - 2. Permanent security fencing and gates
- B. Related sections:
  - 1. Division 03 Section "Cast-in-Place Concrete" for concrete.
  - 2. Division 31 Section "Earth Moving" for site excavation, fill, and backfill.

##### 1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

#### AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A123	2008 Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
ASTM C94	2009 Ready-Mixed Concrete
ASTM F883	2004 Standard Performance Specification for Padlocks
ASTM F1043	2008 Strength and Protective Coatings on Steel Industrial Chain Link Fence Framework
ASTM F969	Practice for Construction of Chain Link Tennis Court Fence

#### FEDERAL SPECIFICATIONS (FS)

FS A-A-59487	(Rev. A) Padlocks (Key Operated)
A-A-59486	(Rev. A) Padlock Set (Individually Keyed Or Keyed Alike)
A-A-1928	(Rev. C) Padlock (Combination)
FF-S-2738	(Rev. A) Seals, Antipilferage



FS RR-F-191	(Rev. K) Fencing, Wire and Post Metal (and Gates, Chain-Link Fence Fabric, and Accessories) (General Specification)
FS RR-F-191/1	(Rev. F) Fencing, Wire and Post, Metal (Chain-Link Fence Fabric) (Detail Specification)
FS RR-F-191/2	(Rev. E) Fencing, Wire and Post, Metal (Chain-Link Fence Gates) (Detail Specification)
FS RR-F-191/3	(Rev. E) Fencing, Wire and Post, Metal (Chain-Link Fence Posts, Top Rails and Braces) (Detail Specification)
FS RR-F-191/4	(Rev. F) Fencing, Wire and Post, Metal (Chain-Link Fence Accessories) (Detail Specification)

#### 1.4 SUBMITTALS

1. Manufacturer's Catalog Data: For each type of product indicated
  - a. Fence and gate posts, rails, and fittings.
  - b. Chain-link fabric, reinforcements, and attachments.
  - c. Accessories
  - d. Gates and hardware
2. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show accessories, hardware, gate operation, and operational clearances.
  - a. Fence and gate posts, rails, and fittings.
  - b. Chain-link fabric, reinforcements, and attachments.
  - c. Accessories
  - d. Gates and hardware
3. Manufacturer's Instructions
  - a. Fencing
4. Product Test Reports: For framing strength according to ASTM F 1043.
5. Warranty: Sample of special warranty.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact.

### PART 2 - PRODUCTS

#### 2.1 CHAIN-LINK FENCING AND ACCESSORIES

- A. FS RR-F-191 and detailed specifications as referenced and other requirements as specified.
- B. Fabric: FS RR-F-191/1; Type I, zinc-coated steel, 9-gauge. Mesh size, 2 inches. Provide selvage knuckled at both selvages. Height of fabric, as indicated on Drawings.



- C. Gates: FS RR-F-191/2; Type I, single swing. Framing and bracing members, round or square of steel or aluminum alloy. Gate frames and braces of minimum sizes listed in FS RR-F-191/3 for each Class and Grade except that steel pipe frames shall be 1.90 inches od, 0.120 inches minimum wall thickness and aluminum pipe frames and intermediate braces shall be 1.869 inches O.D., 0.940 lb/ft of length. Gate fabric, as specified for fencing fabric. Coating for steel latches, stops, hinges, keepers, and accessories, galvanized. Gate latches, fork type. Gate leaves more than 8 feet wide shall have intermediate members as necessary to provide rigid construction, free from sag or twist. Gate leaves less than 8 feet wide shall have truss rods or intermediate braces. Attach gate fabric to gate frame in accordance with manufacturer's standards, except that welding will not be permitted. Arrange padlocking latches to be accessible from both sides of gate, regardless of latching arrangement.
- D. Posts, Top Rails, Bottom Rails and Braces: FS RR-F-191/3 line posts; Class 1, steel pipe. End, corner, and pull posts; Class 1, steel pipe. Braces, rails; Class 1, steel pipe. Top and bottom rails not required for security fence. Top Rail to be 1-5/8" OD, Line posts to be 2-3/8" OD, Terminal posts and Gate posts to be 2-7/8" OD. (4" OD if posts are over 10' in height).
- E. Padlocks: Type EPA or EPB, 1 3/4-inch size, with chain.

## PART 3 - EXECUTION

### 3.1 SITE PREPARATION

- A. Clearing and Grading: Clear fence line of trees, brush, and other obstacles to install fencing. Establish a graded, compacted fence line prior to fencing installation. Compact fill used to establish fence line.
- B. Excavation: Excavate to dimensions indicated for concrete-embedded items, except in bedrock. If bedrock is encountered, continue excavation to depth indicated or 18 inches into bedrock, whichever is less, with a diameter in bedrock a minimum of 2 inches larger than outside diameter of post. Clear post holes of loose material. Dispose of waste material offsite in accordance with Local and State Regulations.

### 3.2 FENCE INSTALLATION

- A. Install fence on prepared surfaces to line and grade indicated. Install fence in accordance with fence manufacturer's written installation instructions except as modified herein.
- B. Post Spacing: Provide line posts spaced equidistantly apart, not exceeding 10-feet on center. Provide gate posts spaced as necessary for size of gate openings. Do not exceed 500 feet on straight runs between braced posts. Provide corner or pull posts, with bracing in both directions, for changes in direction of 15 degrees or more, or for abrupt changes in grade.
- C. Post Setting: Set posts plumb.



- D. Bracing: Brace gate, corner, end, and pull posts to nearest post with a horizontal brace used as a compression member, placed at least 12 inches below top of fence, and a diagonal truss rod and truss tightener used as a tension member.
- E. Top Rails: Install top rails before installing chain-link fabric. Pass top rail through intermediate post caps. Provide expansion coupling spaced as indicated. Top rails not required for temporary security fencing.
- F. Fabric: Pull fabric taut and secure fabric to top rail and bottom rail close to both sides of each post and at maximum intervals of 24 inches on center. Secure fabric to posts using stretcher bars, ties or clips spaced 15 inches on center, or by integrally weaving to integral fastening loops of end, corner, pull, and gate posts for full length of each post. Install fabric on opposite side of posts from area being secured. Install fabric so that bottom of fabric is 2 inches above ground level. Install fence fabric to provide approximately 2-inch deflection at center of fabric span between two posts, when a force of approximately 30 pounds is applied perpendicular to fabric. Fabric should return to its original position when force is removed.

### 3.3 ACCESSORIES INSTALLATION

- A. Post Caps: Install post caps as recommended by the manufacturer.
- B. Supporting Arms: Design supporting arms to accommodate top rail. Install supporting arms as recommended by manufacturer. In addition to manufacturer's standard connections, permanently secure supporting arms to posts. Studs driven by low-velocity powder-actuated tools may be used with steel, wrought iron, ductile iron, or malleable iron. Do not use studs driven by powder-actuated tools with gray iron or other material that will fracture.
- C. Gates: Install swing gates to swing through 180 degrees from closed to open.
- D. Padlocks: Provide padlocks for gate openings and provide chains that are securely attached to gate or gate posts. Provide padlocks keyed alike, and provide two keys for each padlock.

### 3.4 CLEANUP

- A. Remove waste fencing materials and other debris from the station.

END OF SECTION



## SECTION 32 91 19

### LANDSCAPE GRADING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Final grade topsoil for finish landscaping.

##### 1.2 RELATED SECTIONS

- A. Section 31 22 13 - Rough Grading.
- B. Section 31 23 23 - Backfill.

##### 1.3 REFERENCES

- A. ASTM C 602 - Specification For Agricultural Liming Materials.
- B. FS O-F-241 - Fertilizers, Mixed Commercial.

#### PART 2 - PRODUCTS

##### 2.1 MATERIAL

- A. Imported Topsoil, friable loam; free of subsoil, roots, grass, excessive amount of weeds, stone, and foreign matter; acidity range (pH) of 5.5 of 7.5; containing a minimum of four percent and a maximum of 25 percent organic matter, maximum soluble salt content of 500 ppm, maximum of five percent by volume of extraneous material exceeding 2 inches in diameter.

#### PART 3 - EXECUTION

##### 3.1 EXAMINATION

- A. Verify site and trench backfilling has been inspected.
- B. Verify substrate base has been contoured and compacted.

##### 3.2 SUBSTRATE PREPARATION

- A. Eliminate uneven areas and low spots.
- B. Remove debris, roots, branches, stones, in excess of ½ inch in size. Remove subsoil contaminated with petroleum products.
- C. Scarify subgrade to depth of 3 inches where topsoil is scheduled. Scarify in areas where equipment is used for hauling and spreading topsoil and has compacted subsoil.



### 3.3 PLACING TOPSOIL

- A. Place topsoil in areas where seeding, sodding, and/or planting is scheduled. Place topsoil during dry weather.
- B. Fine grade topsoil eliminating rough or low areas. Maintain profiles and contour of subgrade.
- C. Remove roots, weeds, rocks and foreign material while spreading.
- D. Manually spread topsoil close to trees, plants, building, and structures to prevent damage.
- E. Roll placed topsoil.
- F. Remove surplus subsoil and topsoil from site.
- G. Leave stockpile area and site clean and raked, ready to receive landscaping.

### 3.4 SOIL CONDITIONERS – In the event that a healthy growth of grass is not being achieved and it is determined that the topsoil provided is deficient in necessary elements to support healthy plant growth the material may be supplemented with the following items to correct this deficiency.

- A. Dolomitic Limestone: ASTM C 602.
- B. Aluminum Sulphate: Standard commercial grade.
- C. Peat: FS Q-P-166, Type I, Class B.
- D. Perlite: Standard horticultural grade.
- E. Manure: Rotted a minimum of 6 months.
- F. Sawdust: Rotted a minimum of 24 months.
- G. Pesticides: As recommended by Department of Agriculture/Pesticide Control Board.
- H. Fertilizer:
  - 1. FS O-F-241, Type I, Grade B
  - 2. Available nutrients, percent by weight.
    - a. 10 N
    - b. 6 P<sub>2</sub>O<sub>5</sub>
    - c. 4 K<sub>2</sub>O
- I. Water: Harmless to plant growth.



### 3.5 TOLERANCES

- A. Top of Topsoil: Plus or minus ½ inch.

### 3.6 PROTECTION

- A. Protect landscaping and other features remaining as final work.
- B. Protect existing structures, fences, sidewalks, and utilities.

### 3.7 SCHEDULES

- A. Compacted topsoil thickness at the following areas:
  - 1. Grassed Areas: four inches.

END OF SECTION





## SECTION 32 92 19

### SEEDING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Fertilizing.
- B. Seeding.
- C. Hydroseeding.
- D. Seed Protection.
- E. Maintenance.

##### 1.2 RELATED WORK

- A. Section 32 92 19 - Landscape Grading.

##### 1.3 QUALITY ASSURANCE

- A. Comply with all local, state and federal regulations concerning seeding.

##### 1.4 REFERENCE STANDARDS

- A. American Association of State Highway and Transportation Officials (AASHTO):
  - 1. M 145-74, Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes.
- B. American Society for Testing and Materials (ASTM):
  - 1. C 602, Agricultural Liming Materials.
  - 2. D 2487, Classification of Soils for Engineering Purposes.
  - 3. D 977, Emulsified Asphalt.
- C. Federal Specifications:
  - 1. O-F-241, Fertilizer, Mixed, Commercial.
  - 2. O-P-166E, Peat Moss, Peat Humus, Peat, Reed-Sedge.
- D. Maine Department of Transportation (MDOT):
  - 1. Standard Specifications - Highways and Bridges.



## 1.5 SUBMITTALS

### A. Test Reports

1. Provide analysis of topsoil fill in accordance with submittal requirements in Section 01 30 00 – Administrative Provisions.
  - a. Analyze to ascertain percentage of nitrogen, phosphorus, potash, soluble salt content, organic matter content, and pH value.
2. Results of seed purity and germination tests.
3. Results of fertilizer analysis.
4. Results of peat moss analysis.

### B. Certificates

1. Soil conditions and fertilizers.
2. Grass seed.
3. Quarantine restrictions.

## 1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Tag seed, with botanical and common names.
- B. Store and protect seed from excessive heat, cold, sun, rain, wind, and other deleterious environmental conditions.
- C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

## 1.7 JOB CONDITIONS

- A. Place no frozen soils or extremely wet or dry soils.
- B. The seeding process shall meet the following conditions.
  1. Not on or in frozen or extremely wet or dry soils.
  2. Not between June 15 and August 15 or October 1 and April 15.
  3. No seeding when wind exceeds 15 mph.

## 1.8 DEFINITIONS

- A. Weeds: Includes Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lamsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

## 1.9 GUARANTEE

- A. Guarantee seed through one full growing season after planting. Replace if necessary.



## 1.10 MAINTENANCE DATA

- A. Submit maintenance data for continuing Owner maintenance.
- B. Include maintenance instructions, cutting method and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

## PART 2 - PRODUCTS

### 2.1 SUBSOIL

- A. See Section 31 91 19 - Landscape Grading: Products.

### 2.2 TOPSOIL

- A. See Section 31 91 19 - Landscape Grading: Products.

### 2.3 SOIL CONDITIONERS

- A. See Section 31 91 19 - Landscape Grading: Soil Conditioners.

### 2.4 SEED

- A. Lawn Areas: To be installed in areas adjacent to building or areas to be mowed regularly
  - a. MDOT 717.03, Method Number 1: Park Mixture
  - b. Sun/Shade mix, consisting of tall fescue, Kentucky blue, perennial rye, and fine fescue.
- B. Road Areas: To be installed along roadways and embankments
  - a. MDOT 717.03, Method Number 2: Roadside Mixture #3.
  - b. New England Wildflower Mix.

### 2.5 MULCH

- A. Clean hay, wood fiber, jute netting, cheese cloth, burlap, or asphalt emulsion (ASTM D977, Grade SS-1) as appropriate.

### 2.6 ACCESSORIES

- A. Herbicide: Approved chemical registered in State of Maine for stump or basal bark treatment.
- B. Stakes: Softwood lumber, chisel pointed.
- C. String: Inorganic fiber.
- D. Edging: Galvanized steel.



## PART 3 - EXECUTION

### 3.1 INSPECTION

- A. Verify that prepared topsoil is ready to receive the work of this Section.
- B. Beginning of installation means acceptance of existing site conditions.

### 3.2 FERTILIZING

- A. Apply fertilizer at a rate of 25 pounds per 1,000 square feet.
- B. Apply after smooth raking of topsoil and prior to roller compaction.
- C. Do not apply fertilizer at same time or with same machine as will be used to apply seed.
- D. Mix thoroughly into upper 2 inches with an appropriate method.
- E. Lightly water to aid the dissipation of fertilizer.
- F. Water dry topsoil to a depth of 4 inches, 48 hours prior to seeding to obtain a loose, friable seed bed.

### 3.3 SEEDING

- A. Apply seed at a rate of 3 lbs per 1,000 sq. ft. evenly in two intersecting directions. Rake in lightly to a depth of  $\frac{1}{8}$  inch. Do not seed area in excess of that which can be mulched on same day.
- B. Planting Season: April 15 to June 15 or August 15 to October 1.
- C. Do not sow immediately following rain, when ground is too dry, or during windy periods.
- D. Roll seeded area with roller weighing a maximum of 150 lbs/foot of width.
- E. Immediately following seeding and rolling, apply mulch to a thickness of  $\frac{1}{8}$  inches. Maintain clear of shrubs and trees.
- F. Apply water with a fine spray immediately after each area has been mulched. Saturated to 4 inches of soil.

### 3.4 HYDROSEEDING

- A. Apply seeded slurry at a rate of 3 lbs per 1,000 sq. ft. evenly in two intersecting directions, with a hydraulic seeder. Do not hydroseed area in excess of that which can be mulched on same day.
- B. If the Hydroseed mixture does not include mulch, apply mulch to a thickness of  $\frac{1}{8}$  inches immediately following seeding. Maintain clear of shrubs and trees.
- C. Apply water with a fine spray immediately after each area has been mulched. Saturate to 4 inches of soil.



### 3.5 SEED PROTECTION

- A. Cover seeded slopes where grade is 4 inches per foot or greater with erosion fabric. Roll fabric onto slopes without stretching or pulling.
- B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 12-inch overlay of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil.
- C. Secure outside edges and overlaps at 36-inch intervals with stakes.
- D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil.
- E. Erect warning signs and barriers to protect seeded areas.

### 3.6 MAINTENANCE

- A. Mow grass at regular intervals to maintain at a maximum height of 2½ inches. Do not cut more than ⅓ of grass blade at any one mowing.
- B. Neatly trim edges and hand clip where necessary.
- C. Immediately remove clippings after mowing and trimming.
- D. Water to prevent grass and soil from drying out.
- E. Roll surface to remove minor depressions or irregularities.
- F. Control growth of weeds. Apply herbicides in accordance with manufacturer's instructions. Remedy damage resulting from improper use of herbicides.
- G. Immediately reseed areas which show bare spots and maintain seeded areas until project acceptance by Owner.
- H. Protect seeded areas with warning signs during maintenance period.
- I. Grass shall be in a stable state before it can be considered complete. Contractor to warrantee seeded areas for a period of 1 year from the date of install.

END OF SECTION



## SECTION 33 11 13

### PUBLIC WATER UTILITY DISTRIBUTION PIPING

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Installation of water mains, fittings and valves.
- B. Flushing
- C. Testing.

##### 1.2 RELATED SECTIONS

- A. Section 07 21 13 - Board Insulation.
- B. Section 31 23 16 - Excavation.
- C. Section 31 23 17 - Trenching.
- D. Section 31 23 23 - Backfill.
- E. Section 33 13 00 - Disinfection of Water Distribution Systems.
- F. Section 33 21 00 - Water Supply Wells.

##### 1.3 REFERENCE STANDARDS

- A. ANSI A21.4 Cement-mortar lining for ductile iron pipe and fittings for water.
- B. ANSI A21.10 Ductile iron and gray iron fittings 2 in. through 48 in. for water and other liquids.
- C. ANSI A21.11 Rubber-gasket joints for ductile iron and gray iron pressure pipe fittings.
- D. ANSI A21.50 Thickness design for ductile iron pipe.
- E. ANSI A21.51 Ductile iron pipe, centrifugally cast in metal molds or sand-lined molds, for water and other liquids.
- F. ANSI A21.53 Ductile iron compact fittings, 3 in. through 16 in. for water and other liquids.
- G. ANSI B18.2.1 Square and hex bolts and screws, including askew head bolts, hex cap screws, and lag screws.



- H. ANSI/AWWA C110/A21.10 Ductile Iron Tapping Saddles.
- I. ASTM 3035 Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter.
- J. ASTM 3350, Standard Specification for Polyethylene Plastic Pipe and Fitting Materials.
- K. AWWA C500 Gate valves for water and sewerage systems.
- L. AWWA C509 Resilient-seated gate valves, for water and sewerage systems.
- M. AWWA C550 Protective epoxy interior coatings for valves and hydrants.
- N. AWWA C600 Installation of ductile iron water mains and their appurtenances.

#### 1.4 SUBMITTALS

- A. The Maine Water Company will supply the Contractor with the required pipe, fitting, valves, valve boxes, tapping sleeves, joint restraints, fire hydrants, polyethylene wrap, service line (copper and HDPE) service line fittings, curb boxes, tracer wire, brass wedges, and other appurtenances, required, for the proposed water distribution system. The Contractor shall coordinate with the Maine Water Company for the delivery of the materials. Once delivered it is the responsibility of the Contractor to adequately store the materials.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver products on manufacturer's original skids, or in original unopened protective packaging. Remove materials by lifting or skidding. Do not drop any materials.
- B. Store materials in the areas to prevent physical damage.
- C. Protect material during transportation and installation to avoid physical damage.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. Accurately record location of pipe runs, elbows, valves, and other appurtenances.

### PART 2 – PRODUCTS

#### 2.1 GENERAL

- A. All materials, components, products, systems and coatings that come into contact with drinking water must be certified to meet NSF/ANSI Standard 61.



## 2.2 PIPE

- A. High Density Polyethylene (HDPE) Pipe, Conforming to ASTM 3035 and 3350.
  - 1. Class: PE 3408. PE 345434C
  - 2. SDR 9.
  - 3. Joints: Butt fusion weld or Electrofusion coupling
  - 4. Nominal Size: As indicated on Contract Drawings.

## 2.2 FITTINGS

- A. High Density Polyethylene (HDPE)
  - 1. Fittings: Same material as pipe, molded or formed to suit pipe size and end design, in required "T", bends, elbows, cleanouts, reducers, traps, and other configurations required. Polyethylene fittings to be minimum SDR 11 if fabricated rather than molded.
  - 2. All PE pipe connections to fittings or valves of differing materials shall be by an Engineer approved PE Mechanical Joint Adapter.

## 2.3 TRACER WIRE

- A. Tracer Wire shall be a direct bury wire that meets or exceeds the following requirements:
  - 1. Conductor: 12 AWG solid strand soft drawn copper per ASTM B-3. The breaking strength of the wire shall be a minimum of 124 pounds with an O.D. of 0.174. All wire shall be spark tested at 750Q VAC.
  - 2. Insulation: Conductor shall be insulated with high density high molecular weight polyethylene (HDPE) insulation suitable for direct bury applications per ASTM D-1248. The minimum insulation thickness shall be 45 mil. The color of the insulation shall be blue with a print line saying "WATER".
  - 3. Tracer Wire System Manufacturers: Tracing Wire - Pro-Line Safety Products Co. (Pro-Pak Industries, Inc.), or approved equal.
  - 4. Splices: Wire is not to be spliced. Use single length of wire along pipe from valve to valve. Tee connectors along wire are to be provided for each service line.
  - 5. Connectors: Pigtails will be installed by Contractor on all hydrants, valve boxes, and service boxes for connection to tracer wire. Connectors should be capable of handling from 2 to 4 wires per connector and designated as CSA and UL-listed for direct bury applications. DryConn Filled Connectors for Direct Bury Use, DryConn Direct Bury Lug, Aqua (Catalog #90220) and DryConn King 6 Blue wire nuts, no substitutions. PVC adhesives or sealing compounds are not acceptable.
  - 6. Tracer Wire Access Box - Valvco Pipe Tracer Wire Terminal Box or equal. Tracer Wire Access Boxes (if necessary) will be supplied by Owner but tie-in will be Contractor's responsibility.

## 2.4 RETAINER GLANDS

- A. Mechanical joint retainer glands shall be heavy duty ductile iron body, UL or FM approved, and shall have a minimum working pressure rating as follows:

4-inch	350 psi
6-inch	350 psi
8-inch and larger	250 psi





Set screws shall be either "Cor-Ten" steel, ductile iron, or approved equal. The number of set screws shall be equal to or greater than the number of nominal diameter of the gland (i.e. four-inch, four sets of screws; six-inch, six set of screws). GripRings are acceptable replacements for retainer glands for sizes 4" - 12". Larger than 12", Romac RomaGrips may be used. GripRings are not a replacement for thrust blocks. Megalugs are NOT acceptable.

## 2.5 SERVICE LINES

- A. All water service materials shall meet or exceed current ANSI/AWWA-C800 specifications and shall be made in accordance with ASTM B-62. The manufacturer shall furnish a certificate indicating all new materials meet the specifications. All valves, fittings, and pipe shall be inspected several times during the manufacturing process and pressure tested with air under water before shipment. All water service materials shall be visually inspected before installation. Brass and copper are soft metals and care in handling shall be exercised to avoid damaging threads or distorting piping, valves, or fitting bodies.
- B. All water service line material shall be material and size as noted on the drawings, unless otherwise noted. No couplings or connections will be permitted under the paving.
  - 1. Provide swing ties to all services.
  - 2. Cap any unconnected services.
  - 3. Bend pipe with suitable tools to provide smooth bends, free of any cracks or buckles.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Locate no water line in same trench as sewer line unless:
  - 1. Water line rests on solid upper shelf at trench side.
  - 2. 18-inch vertical separation between top of sewer pipe and bottom of water pipe.
  - 3. Horizontal separation between pipes:
    - a. 10-feet minimum typically.
    - b. 5-feet under extenuating circumstances such as trench ledge, providing required vertical separation occurs.
- B. Contractor to furnish swing tie measurements for all services. Swing ties shall be measured from permanent structures; i.e. buildings, utility poles, hydrants, etc.

### 3.2 INSTALLATION

- A. Conform to Manufacturer's recommendation and AWWA Standard C600 for PE pipe, unless otherwise noted.
- B. Water Main Trenches: In accordance to details as shown by Contract Drawings unless otherwise directed.
  - 1. Backfill compaction: per Section 31 23 23.
  - 2. Select material: Notice soil classified as suitable material from trench excavation free of rocks, foreign material, and frozen earth.



- C. Lay no pipe directly on ledge or rock.
- D. Provide bells with bell-hole to remove stress of backfill on unsupported pipe lengths.
- E. Place no rocks or ledge larger than 1-inches within 12 inches of pipe.
- F. Place backfill in maximum 12-inch lifts, compacted per Section 31 23 23.
- G. Increase compaction of successive lifts per Section 31 23 23.
- H. Do not displace or damage pipe during compaction.
- I. Continue backfill placement to grade.
- J. Top of trench to be finished and or prepared for paving.
- K. Protect pipes against impact shocks and free falls.
  - 1. Remove and replace damaged pipe.
  - 2. Place and tamp sufficient bedding material over and around pipe to prevent damage and movement.
- L. Watertight plug open pipe ends when pipe laying not in progress.
- M. Joint deflection not to exceed 5 degrees.
- N. Install additional fittings as required for utility crossings.
- O. Use solid sleeves only with Engineer's approval.
- P. Cut pipe by mechanical methods without damage to pipe or cement lining leaving smooth end at right angles to axis of pipe.
- Q. Bevel cut pipe ends for use with a rubber joint conforming to manufactured spigot end.
- R. Install (4) four bronze wedges at all bell and spigot joints.
- S. Clean pipe of all debris, e.g. rocks, gravel, etc., prior to making connection to existing water main.

### 3.3 FLUSHING

- A. Prior to testing and disinfection, flush the main to remove particulates. The flushing velocity in the main shall be no less than 2.5 feet/second unless the Engineer determines that conditions do not permit the required flow.
- B. The following table indicates rates of flow required to produce a velocity of 2.5 feet /second in pipes of various sizes.



REQUIRED FLOW and OPENINGS to FLUSH PIPELINES (40 psi residual pressure in water main)*					
Pipe Size	Flow Required to Produce 2.5 ft/s (approx.) Velocity in Main	Size of Tap (Inches)			Number of 2.5 in. Hydrant Outlets*
		1"	1.5"	2"	
		Number of Taps on Pipe†			
4"	100 gpm	1	-	-	1
6"	200 gpm	-	1	-	1
8"	400 gpm	-	2	1	1
10"	600 gpm	-	3	2	1
12"	900 gpm	-	-	2	2
16"	1600 gpm	-	-	4	2

\* With a 40-psi pressure in the main with the hydrant flowing to atmosphere, a 2½" hydrant outlet will discharge approximately 1,000 gpm and a 4½" hydrant outlet will discharge approximately 2,500 gpm.

† Number of taps on pipe based on discharge through 5 feet of galvanized pipe with one 90° elbow.

- C. Accomplish flushing by partially opening and closing valves and hydrants several times under expected line pressure.

### 3.6 TESTING

- A. Contact local utility prior to all testing. Provide all labor, equipment, material, gauges, pumps, etc., to test for leaks in accordance with AWWA Standard C600 as follows:
1. Test newly laid pipe and valved sections at hydrostatic pressure of at least 1.5 times working pressure at test location.
    - a. Test pressure: Not less than 150 psi at highest point along line.
    - b. Test pressure: Not to exceed pipe or thrust restraint design pressures.
    - c. Test duration: 2 hours, minimum.
    - d. Pressure variation tolerance: less than +5 psi.
    - e. Test pressure not to exceed valve or hydrant pressure ratings on sections including closed valves or hydrants.
  2. Pressurization of Pipe
    - a. Fill each valved pipe section slowly with water at specified test pressure.
    - b. Apply by means of pump or other approved method.
  3. Air Removal
    - a. Expel all air from pipe, valves, and hydrants before applying test pressure.
    - b. Install corporation stops at high point to vent air if no release valves available.
    - c. After air removal close stops and apply test pressure.
    - d. After test, remove stops and plug holes or leave stops in place permanently if directed by Engineer. Test water to be removed from site and not allowed to remain in trench or on site or cause erosion.
  4. Examination
    - a. Examine exposed pipe, fittings, valves, hydrants, and joints during test.
    - b. Repair or replace defective appurtenances discovered during test.
  5. Leakage Test
    - a. Leakage: Quantity of water supplied to pipe test section to maintain pressure within +5 psi.
    - b. Leakage shall not exceed the following limits:  
$$L = \frac{SD\sqrt{P}}{1000}$$



148,000

L = allowable leakage, in gallons per hour (gph)

S = length of pipe tested in feet

D = nominal pipe diameter, in inches

P = average pressure during test, in pounds per square inch (gauge)

- c. When testing against closed Metal-seated valves, an additional leakage per closed valve of 0.0078 gph/inch of nominal valve size shall be allowed.
- d. Repair visible leaks regardless of leakage amount.
- e. If failing leakage tests:
  - 1. Locate and correct leak.
  - 2. Repeat leakage test until passing test attained.

### 3.7 DISINFECTION OF PIPELINE

- A. Disinfect all new pipelines prior to being placed in service.
- B. Perform disinfection in accordance with Section 33 13 00.

END OF SECTION



## SECTION 33 13 00

### DISINFECTION OF WATER UTILITY SYSTEMS

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Disinfection of potable water distribution system.
- B. Testing and reporting results.

##### 1.2 RELATED SECTIONS

- A. Section 33 11 13 - Public Water Utility Distribution Piping.
- B. Section 33 12 16 - Water Utility Distribution Valves.

##### 1.3 REFERENCES

- A. AWWA C651- Standard for Disinfecting Water Mains.

##### 1.4 SUBMITTALS

- A. Testing Procedure: Indicate proposed methodology in advance for approval of Engineer and local utility district.
- B. Test Reports: Indicate results comparative to specified requirements.
  - 1. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.

##### 1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Section 01 70 00.
- B. Disinfection report:
  - 1. Type and form of disinfectant used.
  - 2. Date and time of disinfectant injection start and time of completion.
  - 3. Test locations.
  - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in parts per million (ppm) for each outlet tested.
  - 5. Date and time of flushing start and completion.
  - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- C. Bacteriological report; record:
  - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
  - 2. Time and date of water sample collection.
  - 3. Name of person collecting samples.
  - 4. Test locations.
  - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
  - 6. Certification that water conforms, or fails to conform, to bacterial standards of State Public Health Department.
  - 7. Bacteriologist's signature and authority.



## 1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with AWWA C651.

## 1.7 REGULATORY REQUIREMENTS

- A. Conform to State Public Health Department code or regulation for performing the work of this Section.
- B. Provide certificate of compliance from local Utility District indicating approval of water system.

## PART 2 - EXECUTION

### 2.1 EXAMINATION

- A. Verify that piping system has been cleaned, inspected, and pressure tested.
- B. Perform scheduling and disinfection activity with start-up, testing, adjusting and balancing, demonstration procedures, including coordination with related systems.

### 2.2 EXECUTION

- A. Provide and attach required equipment to perform the work of this Section.
- B. Inject treatment disinfectant into piping system.
- C. Maintain disinfectant in system for 24 hours.
- D. Flush, circulate and clean until required cleanliness is achieved; use municipal domestic water.
- E. Replace permanent system devices removed for disinfection.
- F. Dechlorinate wasted water as directed by the Engineer to thoroughly neutralize the residual chlorine.

### 2.3 QUALITY CONTROL

- A. Test samples in accordance with AWWA C651.

END OF SECTION



## SECTION 33 21 00

### WATER SUPPLY WELLS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Rotary drilled water supply wells.
- B. Related sections:
  - 1. Division 01 Section "Temporary Facilities and Controls" for temporary utilities, temporary construction and support facilities, temporary security and protection facilities procedures.
  - 2. Division 22 Section "Plumbing" for plumbing connections.
  - 3. Division 32 Section "Trenching" for excavating, placing pipe, and backfilling of related utility.
  - 4. Division 32 Section "Landscape Grading" for finish grading including preparing and placing planting soil mixes and testing of topsoil material.
  - 5. Division 32 Section "Seeding" for preparing and placing finish surface turf establishment.
  - 6. Division 33 Section "Public Water Utility Distribution Piping" for utility distribution piping.

##### 1.3 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI B1.20.1 Pipe Threads, General Purpose (Inch)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A53 Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA C601 Disinfecting Water Mains

ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 570/9-75-001 Manual of Water Well Construction Practices



## 1.4 SUBMITTALS

- A. Drawings: Shop Drawings: Shop drawings or catalog cuts showing well casings detail drawings or catalog cuts shall be accompanied by a cross section showing the relative size, location, and spacing of the well components such as the hole size, outer casing, well screen, gravel filter, air line and gauge, and grout.
- B. Operation and Maintenance Data: For each well pump to include in emergency, operation, and maintenance manuals.
- C. Project Record Documents: Record the following data for each water supply well:
  - 1. Casings: Material, diameter, thickness, weight per foot of length, and depth below grade.
  - 2. Screen: Material, construction, diameter, and opening size.
  - 3. Pumping Test: Static water level, maximum safe yield, and drawdown at maximum yield.
  - 4. Log: Formation log indicating strata encountered.
  - 5. Alignment: Certification that well is aligned and plumb within specified tolerances.
- D. Test Reports:
  - 1. Certified Data:
    - a. Pump test
    - b. Water analysis
    - c. Plumbness and alignment test
- E. Recommendation and Data Submittal: Include with the recommendations the appropriate depth, details of construction, length and location of screens, screen openings, gravel size, grout, and an estimation of the quantity of water that can be obtained from each water-bearing stratum and from each completed well. Submit electric log, a drillers log drawn to scale with coarseness and fineness modulus of each strata, time penetration log (time to drill through each formation), and sieve analysis to substantiate recommendations.

## 1.5 QUALITY ASSURANCE

- A. Well Driller Qualifications: An experienced water supply well driller licensed in the jurisdiction where Project is located.
- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7.
- C. 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.





- D. Comply with AWWA A100 for water supply wells.

## 1.6 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Architect and Owner no fewer than seven days in advance of proposed interruption of water service.
  - 2. Do not proceed with interruption of water service without Architect's and Owner's written permission.
- B. Well Drilling Water: Provide temporary water and piping for drilling purposes. Provide necessary piping for water supply.

## 1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Deliver materials in an undamaged condition. Store materials off the ground to provide protection against oxidation caused by ground contact. Replace defective or damaged materials with new materials.

## 1.8 GENERAL REQUIREMENTS

- A. Provide each system complete and ready for operation. Each system, including equipment, materials, installation, and workmanship shall be in accordance with EPA 570/9-75-001, except as modified herein. In the manual referred to herein, the advisory provisions shall be considered mandatory, as though the word "shall" has been substituted for the word "should" wherever it appears.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Shall conform to the respective specifications and other requirements as specified herein.
- B. Casings: ASTM A53; black steel pipe 6" nominal diameter with threaded ends and threaded couplings for threaded joints. Provide cap, with holes for piping and cables that fits into the top of the casing and is removable, waterproof and vermin proof. Provide set screws for casing cap.
- C. Well Screens: Type 304 or 316 stainless steel, type. Provide screens with adequate strength to resist external forces, both during and after installation. Length shall be as required to provide the quantity of water specified. Water velocity through openings shall not exceed 0.1 foot per second. Determine the well screen openings from an analysis of the sand in the water-bearing strata. Provide joints of the same material as the screen, with either threaded rings or butt-type welding rings.



- D. Auxiliary Equipment: Provide discharge piping to dispose of pumped water during developing and testing of well. Locate the discharge piping a sufficient distance from each well to prevent flooding of the site and flow back into the well.
- E. Grout: Cement: ASTM C 150, Type II; Aggregates: ASTM C 33, fine and coarse grades; Water: Potable.
- F. Pack Materials: Coarse, uniformly graded filter sand, maximum 1/8 inch in diameter; fine gravel, maximum 1/4 inch in diameter.

## 2.2 SUBMERSIBLE WELL PUMPS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
  - 1. Aermotor Pumps, Inc.
  - 2. American Turbine Pump Co.
  - 3. Crane Pumps and Systems; Deming Pumps.
  - 4. Grundfos.
  - 5. ITT Industries; Goulds Pumps.
  - 6. Jacuzzi, Inc.; Jacuzzi Brothers.
  - 7. Johnston Pump Company.
  - 8. McDonald, A. Y. Mfg. Co.
  - 9. Pentair Pump Group; Layne/Verti-Line.
  - 10. Pentair Pump Group; Myers, F. E.
  - 11. Reda Productions Services; Schlumberger Limited.
  - 12. Sta-Rite Industries, Inc.; Water Systems Group.
  - 13. Sterling Fluid Systems (USA) Inc.; Peerless Pump.
  - 14. USFilter/EMU Products.
  - 15. Weber Industries, Inc.
- D. Description: Submersible, vertical-turbine well pump complying with HI 2.1-2.2 and HI 2.3; with the following features:
  - 1. Impeller Material: Stainless steel.
  - 2. Motor: Capable of continuous operation under water, with protected submersible power cable.
  - 3. Column Pipe: ASTM A 53/A 53M, Schedule 40, galvanized-steel pipe with threaded ends and cast-iron or steel threaded couplings.
  - 4. Water Piping: ASTM D 2239, SDR Numbers 5.3, 7, or 9 PE pipe; made with PE compound number required to give pressure rating not less than 200 psig. Include NSF listing mark "NSF pw". Fittings for PE Pipe: ASTM D 2609, made of PA,



PP, or PVC with serrated, male insert ends matching inside of pipe. Include bands or crimp rings.

## PART 3 - EXECUTION

### 3.1 TEST HOLE

- A. Drill a test hole at the well site, as indicated in the Contract Documents, before construction of the permanent well is started. Test hole shall be of sufficient size to obtain information required for the construction of the permanent well.

### 3.2 WELL CONSTRUCTION

- A. The depth of the well shall be adequate to produce a guaranteed capacity of a set gallons per minute of clear, potable water equal to or greater than the current well. Methods of construction include using drilling mud for conventional fluid rotary drilling or reverse circulation drilling.
- B. Drilling: Drill a hole 6 inches in diameter to a minimum depth of 300 feet and to additional depths as required to produce the flow capacity required.
- C. Sanitary Seal: Provide a sanitary seal for the well to prevent contamination until the pump foundation
- D. Take samples of substrata formation at 10-foot intervals and at changes in formation throughout entire depth of each water supply well. Carefully preserve samples on-site in glass jars properly labeled for identification.
- E. Enlarge test hole and install permanent casing, screen, and grout. Install first section of casing with hardened steel driving shoe of an OD slightly larger than casing couplings if threaded couplings are used.
- F. Set casing and liners round, plumb, and true to line. Install the casing concentrically in the drilled hole and extend the casing down to a seat properly into ledge. Provide threaded joints in accordance with ANSI B1.20.1.
- G. Join casing pipe as follows:
  - 1. Ream ends of pipe and remove burrs.
  - 2. Remove scale, slag, dirt, and debris from inside and outside casing before installation.
  - 3. Cut bevel in ends of casing pipe and make threaded joints.
  - 4. Clean and make solvent-cemented joints.
- H. Mix grout in proportions of 1 cu. ft. or a 94-lb sack of cement with 5 to 6 gal. of water. Bentonite clay may be added in amounts of 3 to 5 lb/cu. ft. for a 94-lb sack of cement. If bentonite clay is added, water may be increased to 6.5 gal./cu. ft. of cement.



- I. Place grout continuously, from bottom to top surface, to ensure filling of annular space in one operation. Do not perform other operations in well within 72 hours after grouting of casing. When quick-setting cement is used, this period may be reduced to 24 hours.
- J. Provide permanent casing with temporary well cap. Install with top of casing 36 inches above finished grade.
- K. Develop wells to maximum yield per foot of drawdown.
  - 1. Extract maximum practical quantity of sand, drill fluid, and other fine materials from water-bearing formation.
  - 2. Avoid settlement and disturbance of strata above water-bearing formation.
  - 3. Do not disturb sealing around well casings.
  - 4. Continue developing wells until water contains no more than 2 ppm of sand by weight when pumped at maximum testing rate.
- L. Install submersible well pumps according to HI 2.1-2.4 and provide access for periodic maintenance.
  - 1. Before lowering permanent pump into well, lower a dummy pump that is slightly longer and wider than permanent pump to determine that permanent pump can be installed. Correct alignment problems.
  - 2. Before lowering permanent pump into well, start pump to verify correct rotation.
  - 3. Securely tighten discharge piping joints.
  - 4. Locate line-shaft well pump near well bottom; locate motor above grade. Install driver plate to correctly align motor and pump.
  - 5. Connect motor to submersible pump and locate near well bottom.
    - a. Connect power cable while connection points are dry and undamaged.
    - b. Do not damage power cable during installation; use cable clamps that do not have sharp edges.
- M. Install water-sealed surface plate that will support pump and piping.
- N. Disinfection: Disinfect well, equipment, and material in accordance with Article 54 of EPA 570/9-75-001 and as specified herein. Portions of the well above the water level shall be maintained in a wet condition with a minimum of 50 ppm of free available chlorine for a period of not less than 30 minutes. A stock chlorine solution sufficient to produce 50 ppm of free available chlorine throughout the water in the well shall be added to the well at different water level intervals from top to bottom and then agitated to distribute the chlorine solution evenly throughout the well. The chlorine shall remain in the well for a minimum of 12 hours. After the 12-hour period, pump the well free of chlorine. Disinfect piping in accordance with AWWA C601.

### 3.3 WELL ABANDONMENT

- A. Comply with AWWA A100 when abandoning water supply wells. Fill and seal holes and casings and restore ground surface to finished grade.



- B. Follow well-abandonment procedures of authorities having jurisdiction. Restore ground surface to finished grade.
- C. Abandoned test holes, including test wells, partially completed wells, and completed wells, shall be sealed for the following reasons:
  - 1. To eliminate physical hazards,
  - 2. To prevent contamination of groundwater,
  - 3. To conserve yield and hydrostatic head of aquifer, and
  - 4. To prevent intermingling of desirable and undesirable waters.
  - 5. The guiding principle to be followed by the contractor in the sealing of abandoned wells is the restoration, as far as feasible, of the controlling geological conditions that existed before the well was drilled or constructed.
- D. Sealing requirements
  - 1. A well shall be measured for depth before it is sealed to ensure freedom from obstructions that may interfere with effective sealing operations.
  - 2. Removal of casing from some wells may be necessary to ensure placement of an effective seal.
  - 3. If the casing cannot be readily removed, it shall be perforated to ensure the proper sealing required.
  - 4. Concrete, cement grout, sealing clay or neat cement shall be used as primary sealing materials and shall be placed from the bottom upward by methods that will avoid segregation or dilution of material.
  - 5. If possible, the casing should be removed and the borehole filled with a cement-bentonite slurry. If the casing cannot be removed, the entire well should be filled with a cement-bentonite slurry using the pump-down method with a tremie pipe. The top of the casing shall be cut off at or below the ground surface before plugging operations begin. After filling the well with the cement-bentonite slurry, the excavation above the top of the cement plug shall be filled with compacted soil to minimize future hazards to equipment.
- E. Records of Abandonment Procedures
  - 1. Complete, accurate records shall be kept of the entire abandonment procedure to provide detailed records for possible future reference and to demonstrate to the governing state or local agency that the hole was properly sealed.
  - 2. The depth of each layer of all sealing and backfilling materials shall be recorded.
  - 3. The quantity of sealing materials used shall be recorded. Measurements of static water levels and depths shall be recorded.
  - 4. Any changes in the well made during the plugging or sealing, such as perforating casing, shall be recorded in detail.

### 3.4 WASTE DISPOSAL

- A. Dispose of waste materials and soil removed from the drilled holes as required.

### 3.5 FIELD SAMPLING AND TESTING



- A. All testing shall be performed by a qualified Independent Testing Laboratory acceptable to the Engineer and General Contractor at the Owner's expense unless otherwise indicated (see Section 01 40 00 - Quality Requirements). The General Contractor shall arrange for all testing.
- B. Water Analysis Testing:
  - 1. Owner will engage a qualified testing agency to make bacteriological, physical, and chemical analyses of water from each finished well and report the results. Make analyses according to requirements of authorities having jurisdiction.
  - 2. Analyze water sample from each finished well for bacteriological, physical, and chemical quality and report the results. Make analyses according to requirements of authorities having jurisdiction.
- C. Material Samples: During drilling of test hole, take samples of materials found in each soil stratum. Preserve samples in approved containers furnished by the Contractor.
- D. Water Quality Determination: During drilling of test hole, collect, and have analyzed by a DEP present representative. Perform water sampling in accordance with Article 45 of the EPA 570/9-75-001. Include bacteriological and physical-chemical analysis, and further include field and routine analysis data contained in Parts I and III of DD Form 710, Physical and Chemical Analysis of Water, which accompanies this specification. In addition, analyze the water for any additional suspected minerals or contaminants which would make it unfit for human consumption, such as nitrate, fluoride, mercury, or any other contaminants.
- E. Pump Test: Upon completion of permanent well, provide a temporary pump, meter, air gauge, and air line in the well for measuring the flow and drawdown. The temporary pump shall have a capacity of not less than 10 gallons per minute. After determining the static water level in the well, begin pumping at a rate equal to 60 percent of the guaranteed capacity rate and check the drawdown at 15-minute intervals until drawdown stabilizes. Measure drawdown using the air line method. Continue pumping at that rate for 2 hours and check the water level at 30-minute intervals. Increase pumping rate in uniform increments of 20 percent of the guaranteed capacity rate and repeat described procedure at each increment of increased rate until the capacity of the well is determined or the 160 percent increment of the guaranteed capacity rate is reached. After determining the safe maximum yield of the well, conduct a continuous 24-hour pump test at that rate and check the drawdown at hourly intervals. Provide pipe and ditches to drain the water from the well site. Furnish a complete written log of the pump test, showing static water level, pumping rate, and drawdown at the specified intervals. Remove air line at completion of pump test. At the end of the 24-hour test and disinfection procedure, submit water samples to an approved testing laboratory for complete chemical and bacteriological analysis. Furnish additional samples as required by authorities having jurisdiction.
- F. Well Plumbness and Alignment Test: Upon completion of the permanent well, provide a well plumbness and alignment test using a plummet in accordance with Article 51 of the EPA 570/9-75-001. Perform the test on the entire depth of the well. The plumb or



dummy shall move freely through the entire depth of the well. The well shall not vary from the vertical in excess of two-thirds of the smallest inside diameter of that part of the well being tested per 100 feet of depth. Correct defects in plumbness and alignment, and repeat test until the work is in compliance with contract requirements.

### 3.6 CLEANING

- A. Disinfect water supply wells according to AWWA A100 and AWWA C654 before testing well pumps.
- B. Follow water supply well disinfection procedures required by authorities having jurisdiction before testing well pumps.

### 3.7 PROTECTION

- A. Water Quality Protection: Prevent well contamination, including undesirable physical and chemical characteristics.
- B. Ensure that mud pit will not leak or overflow into streams or wetlands. When well is accepted, remove mud and solids in mud pit from Project site and restore site to finished grade.
- C. Provide casings, seals, sterilizing agents, and other materials to eliminate contamination; shut off contaminated water.
- D. Exercise care to prevent breakdown or collapse of strata overlaying that from which water is to be drawn.
- E. Protect water supply wells to prevent tampering and introducing foreign matter. Retain temporary well cap until installation is complete.

END OF SECTION