



PROJECT MANUAL  
HARRINGTON FAMILY HEALTH CENTER  
ADDITION AND RENOVATION

BID DOCUMENTS  
19 DECEMBER 2022



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DOCUMENT 00 01 01 - PROJECT TITLE PAGE

**PROJECT MANUAL** Bid Documents

Harrington Family Health Center

50 East Main Street, Harrington, ME 04643

Harrington Family Health Center

Belinda Fletcher, Chief Executive Officer

Architect Project No. 662

Sealander Architects

79 Main Street, Suite C

Ellsworth, ME 04605

Phone: 207.266.5822

Web Site: [sealanderarchitects.com](http://sealanderarchitects.com)

Issued: 19 December 2022

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END OF DOCUMENT 00 01 01





## DOCUMENT 00 11 13 - ADVERTISEMENT FOR BIDS

## 1.1 PROJECT INFORMATION

- A. Notice to Bidders: Qualified Bidders may submit Bids for project as described in this Document. Submit Bids according to the Instructions to Bidders.
- B. Project Identification: Harrington Family Health Center Addition and Renovation.
  - 1. Project Location: 50 East Main Street, Harrington, ME 04643.
- C. Owner: Harrington Family Health Center, 50 East Main Street, Harrington, ME 04643.
- D. Architect: Sealander Architects. Mike Sealander, AIA, 207.266.5822.
- E. Project Description: Interior renovations to move break room and conference room to the old part of the building and create a dental suite. Create a new stair addition.
- F. Construction Contract: Bids will be received for the following Work:
  - 1. General Contract (all trades).

## 1.2 BID SUBMITTAL AND OPENING

- A. Owner will receive sealed lump sum Bids until the Bid time and date at the location given below. Bids shall be in an envelope plainly marked "Bid for Harrington Family Health Center" and addressed to:
  - Jessica Ackley, Chief Financial Officer, Harrington Family Health Center, 50 East Main Street, Harrington, ME 04643.

Bids will be opened and read aloud at the Harrington Family Health Center, 50 East Main Street, Harrington, ME 04643 at 2:00 p.m., local time, on Thursday, January 19, 2023. Bids submitted after the noted time will not be considered and will be returned unopened.
- B. The Bid shall be submitted on the Bid Form (Document 00 41 13) provided in the Bid Documents.
- C. Owner reserves the right to reject any and all Bids and to waive informalities and irregularities.
- D. Bid security is required on this project. Bidder shall include a satisfactory Bid Bond or a certified or cashier's check for 5% of the Bid amount with the completed Bid form submitted to the Owner.
- E. Performance and Payment Bonds are required on this project. The selected Contractor shall furnish a 100% contract Performance Bond and a 100% contract Payment Bond in the contract amount to cover the execution of the Work.

### 1.3 PREBID MEETING

- A. Prebid Meeting: An optional Prebid meeting for all Bidders will be held at project site, 50 East Main Street, Harrington, ME 04643, at 9:00 a.m on Thursday, January 5, 2023. Attendees must pre-register for Prebid meeting by contacting Mike Sealander [mike@sealanderarchitects.com](mailto:mike@sealanderarchitects.com). Deadline to pre-register for Prebid meeting is January 3, 2023 at 5:00 p.m. Meeting will be scheduled to allow for safe social distancing. Prospective prime Bidders are advised to attend.

### 1.4 PREBID REGISTRATION

- A. Bidders are advised to register with Architect in order to receive updates. To register, send an email to [mike@sealanderarchitects.com](mailto:mike@sealanderarchitects.com) with the subject line “Harrington Family Health Center Bid.”
- B. Questions shall be submitted by email to [mike@sealanderarchitects.com](mailto:mike@sealanderarchitects.com) not later than January 9, 2023 at 5:00 p.m. local time. Responses will include the original question and be distributed to registered parties by email. Responses to questions will be issued not later than January 12, 2023.

### 1.5 DOCUMENTS

- A. Printed Procurement and Contracting Documents will be available on or about December 19, 2022.
- B. Electronic Procurement and Contracting Documents: Obtain PDFs at no charge by contacting [mike@sealanderarchitects.com](mailto:mike@sealanderarchitects.com) 207-266-5822.

### 1.6 TIME OF COMPLETION AND LIQUIDATED DAMAGES

- A. Successful Bidder shall begin the Work on receipt of the Notice to Proceed and shall complete the Work within the Contract Time. Work is subject to liquidated damages.

### 1.7 BIDDER'S QUALIFICATIONS

- A. Bidders must be properly licensed under the laws governing their respective trades and be able to obtain insurance and bonds required for the Work.

### 1.8 NOTIFICATION

- A. This Advertisement for Bids document is issued by the Harrington Family Health Center, 50 East Main Street, Harrington, ME 04643.

END OF DOCUMENT 00 11 13

## DOCUMENT 00 21 13 - INSTRUCTIONS TO BIDDERS

## 1.1 BIDDER REQUIREMENTS

- A. A Bidder is a Contractor who is qualified to Bid on the proposed project described in the Bid Documents.
- B. Contractors 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. Owner may require additional information to determine if the activities of a Contractor constitute an unfair Bidding advantage.
- C. 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 for any obligation with respect to their Bid or the execution of the work as a Contractor.
- D. Prior to the award of the contract, General Contractor Bidders may be required to provide documented evidence to the Owner showing compliance with the provisions of this section, their business experience, financial capability, or performance on previous projects.
- E. The selected General Contractor Bidder shall be required to provide proof of insurance before a contract can be executed.
- F. Each Bid shall be accompanied by a Bid security in the form and amount required as stipulated in the Instructions to Bidders. The Bidder pledges to enter into a Contract with the Owner on the terms stated in the Bid and will, if required, furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Should the Bidder refuse to enter into such Contract or fail to furnish such bonds if required, the amount of the Bid security shall be forfeited to the Owner as liquidated damages, not as a penalty.
- G. Contracts developed from this Bid shall not be assigned, sublet or transferred without the written consent of the Owner.
- H. The Bidder shall furnish bonds covering the faithful performance of the Contract and payment of all obligations arising thereunder. Bonds may be secured through the Bidder's usual sources. The cost of such bonds shall be included in the Bid.

## 1.2 AUTHORITY OF OWNER

- A. The Owner reserves the right to accept or reject any or all Bids as may best serve the interest of the Owner.

- B. 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 sum of the lowest acceptable Bid plus any Alternate Bids the Owner elects to include as well as Contractor's demonstrated ability to adhere to Contract Documents and schedule.

### 1.3 SUBMITTING BIDS AND BID REQUIREMENTS

- A. Each Bid shall be valid for a period of thirty (30) calendar days following the Project Bid opening date and time.
- B. A Bid that contains an escalation clause is considered invalid.
- C. Bidders may modify Bids in writing prior to the Bid closing time. Such written amendments shall not disclose the amount of the initial Bid. If so disclosed, the entire Bid shall be considered invalid.
- D. Bidders shall acknowledge on the Bid form all Addenda issued in a timely manner. The Architect shall not issue Addenda affecting Bidders less than 72 hours prior to the Bid closing time. Addenda shall be issued to all companies who are registered holders of Bid Documents.
- E. 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 Owner. After the Bid closing time, such written withdrawal requests may be allowed if the Contractor provides documented evidence to the satisfaction of the Owner that factual errors had been made on the Bid form.

END OF DOCUMENT 00 21 13

DOCUMENT 00 41 13 - BID FORM - STIPULATED SUM (SINGLE-PRIME CONTRACT)

1.1 BID INFORMATION

- A. Bidder: \_\_\_\_\_.
- B. Project Name: Harrington Family Health Center.
- C. Project Location: 50 East Main Street, Harrington, ME 04643.
- D. Owner: Harrington Family Health Center.
- E. Architect: Sealander Architects.
- F. Architect Project Number: 662.

1.2 CERTIFICATIONS AND BASE BID

- A. Base Bid, Single-Prime (All Trades) Contract: The undersigned Bidder, having carefully examined the Procurement and Contracting Requirements, Conditions of the Contract, Drawings, Specifications, and all subsequent Addenda, as prepared by Sealander Architects and Architect's consultants, having visited the site, and being familiar with all conditions and requirements of the Work, hereby agrees to furnish all material, labor, equipment and services, including all scheduled allowances, necessary to complete the construction of the above-named project, according to the requirements of the Procurement and Contracting Documents, for the stipulated sum of:
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_).

1.3 UNIT PRICES – See 01 22 00

- A. Base Bid: Remove and Reinstall hollow metal door frames at doors to be Removed and Reinstalled.
- B. Unit-Price No. 1: Hollow Metal Door Frames.
  - 1. \_\_\_\_\_ Dollars (\$\_\_\_\_\_ ) per unit.

1.4 BONDS

- A. A completed Bid Bond form is required to be attached to the Bid Form.
- B. Base Bid shall include the cost of a 100% Contract Performance Bond and 100% Contract Payment Bond.

1.5 TIME OF COMPLETION

- A. The undersigned Bidder proposes and agrees hereby to commence the Work of the Contract Documents on a date specified in a written Notice to Proceed to be issued by Architect.
- B. The Work shall be conducted in two phases. The total duration of both phases combined shall be seven consecutive months. Substantial Completion of Phase 2 shall be no later than January 1, 2024.

1.6 LIQUIDATED DAMAGES

- A. \$500.00 per day beyond contractual substantial completion date.

1.7 ACKNOWLEDGEMENT OF ADDENDA

- A. The undersigned Bidder acknowledges receipt of and use of the following Addenda in the preparation of this Bid:
  - 1. Addendum No. 1, dated \_\_\_\_\_.
  - 2. Addendum No. 2, dated \_\_\_\_\_.
  - 3. Addendum No. 3, dated \_\_\_\_\_.

1.8 SUBMISSION OF BID

- A. The undersigned agrees, if this proposal is accepted, to sign a contract and deliver it, along with the bonds and affidavits of all insurance specified within twelve (12) calendar days after the date of notification of such acceptance, except if the 12<sup>th</sup> day falls on a holiday, a Saturday or Sunday, then the conditions will be fulfilled in the required documents are received before 12:00 noon on the day following the holiday, or the Monday following the Saturday or Sunday, and as a guarantee thereof, herewith submits a certified cashier’s check or bid bond as required.

Respectfully submitted this \_\_\_\_ day of \_\_\_\_\_, 2023.

Submitted By: \_\_\_\_\_  
(Name of Bidding firm or corporation)

Authorized Signature: \_\_\_\_\_  
(Handwritten signature)

Signed By: \_\_\_\_\_  
(Type or print name)

Title: \_\_\_\_\_  
(Owner/Partner/President/Vice President)

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

City, State, Zip \_\_\_\_\_

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

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

State of incorporation: \_\_\_\_\_  
(If Bidder is a corporation)

Names of all partners: \_\_\_\_\_  
(If Bidder is a partnership)

(Affix Corporate Seal Here)

END OF DOCUMENT 00 41 13





## DOCUMENT 00 43 13 – CONTRACTOR BID BOND (SAMPLE)

We, the undersigned, [*insert 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 day, i.e.: 8<sup>th</sup>*] day of [*select month*], [*select year*], which is the same date as that of the bid due date.

The condition of the above obligation is such that whereas the principal has submitted to the Owner, 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.

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 day, i.e.: 8<sup>th</sup>]* day of *[select month]*, *[select year]*, which is the same date as that of 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.

END OF DOCUMENT 00 43 13

DOCUMENT 00 52 00 – STANDARD FORM OF AGREEMENT

1.1 INSERT FORM OF AGREEMENT HERE

- A. AIA Document A101-2017, "Standard Form of Agreement between Owner and Contractor, Stipulated Sum."



## DOCUMENT 00 61 13.13 – CONTRACTOR PERFORMANCE BOND (SAMPLE)

Bond No.: *[insert bond number]*

We, the undersigned, *[insert 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 conditions of the above obligation is such that if the principal shall promptly and faithfully perform the contract entered into this *[insert day, i.e.: 8<sup>th</sup>]* day of *[select month]*, *[select year]*, which is the same date as that of 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.

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 day, i.e.: 8<sup>th</sup>]* day of *[select month]*, *[select year]*, which is the same date as that of 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.

END OF DOCUMENT 00 61 13.13

## DOCUMENT 00 61 13.16 – CONTRACTOR PAYMENT BOND (SAMPLE)

Bond No.: *[insert bond number]*

We, the undersigned, *[insert 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 of 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 conditions 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 day, i.e.: 8<sup>th</sup>]* day of *[select month]*, *[select year]*, which is the same date as that of 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.

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 day, i.e.: 8<sup>th</sup>]* day of *[select month]*, *[select year]*, which is the same date as that of 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.

END OF DOCUMENT 00 61 13.16



DOCUMENT 00 70 00 – GENERAL CONDITIONS

1.1 INSERT GENERAL CONDITIONS HERE

- A. AIA Document A201-2017, "General Conditions of the Contract for Construction."



## DOCUMENT 00 73 00 – INSURANCE REQUIREMENTS

The Contractor shall not commence work under this contract until the Contractor has obtained all insurance required under this article and such insurance has been approved by the Owner, nor shall the Contractor allow any Sub-Contractor to commence work on a subcontract until all similar insurance required of the Sub-Contractor has been so obtained and approved.

The Owner does not warrant or represent that the insurance required under this paragraph constitutes an insurance portfolio which adequately addresses all risks faced by the Contractor or its Sub-Contractors. The Contractor and Sub-Contractors of every tier shall satisfy themselves as to the existence, extent and adequacy of insurance prior to commencement of work.

The Contractor and any Sub-Contractor shall procure and maintain for the duration of the Project insurance of the types and limits set forth under this paragraph and such insurance as will protect themselves from claims which may arise out of or result from the Contractor's or Sub-Contractor's execution of the work, whether such execution be by themselves or by anyone directly or indirectly employed by any of them or by anyone for whose acts any of them may be liable. The insurance coverage provided by the Contractor and any Sub-Contractor will be primary coverage. All required insurance coverages shall be placed with carriers authorized to conduct business in the State of Maine.

#### A. Workers' Compensation Insurance

Worker's compensation insurance for all employees on site in accordance with the statutory 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.

#### B. Liability Insurance

##### 1. General Liability Insurance

General liability insurance shall be on a form providing coverage not less than that of the 1996 occurrence version of the Insurance Services Office (ISO) Commercial General Liability Policy. This insurance shall cover 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. It shall include collapse and underground coverage - as well as explosion coverage if explosion hazards exist. Aggregate limits shall apply on a per 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

## 2. Automobile Liability Insurance

Automobile liability insurance against claims for bodily injury, death or property damage resulting from the maintenance, Ownership or use of all owned, nonowned and hired automobiles, trucks and trailers.

Minimum acceptable limit is \$1,000,000 any one accident or loss.

## 3. Owners Protective Liability

For Contracts exceeding \$50,000 in total Contract amount, Contractor shall secure an Owners Protective Liability policy naming the Owner as the Named Insured.

Minimum acceptable limits are:

General aggregate limit: \$2,000,000

Each occurrence limit: \$1,000,000

## 4. Pollution Liability

In the event that any disruption, handling, abatement, remediation, encapsulation, removal, transport, or disposal of contaminated or hazardous material is required, the Contractor or its Sub-Contractor shall secure a pollution liability policy in addition to any other coverages contained in this section. The insurance shall be provided on an occurrence based policy and shall remain in effect for the duration of the Project.

Minimum acceptable limit is \$1,000,000 per occurrence.

## C. Property Insurance

The Owner shall procure and maintain Builder's Risk insurance

## D. Certificates of Insurance

Four original copies of all certificates of insurance in a form and issued by companies acceptable to the Owner shall be provided to the Designer prior to commencement of work. The certificates shall name the Owner as certificate holder and shall contain a provision that coverage afforded under the insurance policies will not be canceled or materially changed unless at least thirty (30) days prior written notice by registered letter has been given to the Owner.

END OF DOCUMENT 00 73 00

## SECTION 01 10 00 - SUMMARY

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Project information.
2. Work covered by Contract Documents.
3. Phased Construction.
4. Access to site.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and drawing conventions.

## B. Related Requirements:

1. Section 01 50 00 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

## 1.2 PROJECT INFORMATION

## A. Project Identification: Harrington Family Health Center.

1. Project Location: 50 East Main Street, Harrington, ME 04643.

## B. Owner: Harrington Family Health Center.

C. Architect: Sealander Architects, 79 Main Street, Suite C, Ellsworth, ME 04605.  
[mike@sealanderarchitects.com](mailto:mike@sealanderarchitects.com) 207.266.5822.

## 1.3 WORK COVERED BY CONTRACT DOCUMENTS

## A. The Work of Project is defined by the Contract Documents and consists of the following: Interior renovations to move break room and conference room to the old part of the building and create a dental suite. Create a new stair addition.

## B. Type of Contract.

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

#### 1.4 PHASED CONSTRUCTION

- A. The Work shall be conducted in two phases. The total duration of both phases combined shall be seven consecutive months. Substantial Completion of Phase 2 shall be no later than January 1, 2024.
- B. Before commencing Work of each phase, submit an updated copy of Contractor's construction schedule showing the sequence, commencement and completion dates for all phases of the Work.

#### 1.5 ACCESS TO SITE

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

#### 1.6 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy site and existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated.
  - 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.
  - 2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
  - 3. Owner's operations preclude interruptions in electric power service.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
  - 1. Architect will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
  - 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
  - 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.

4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

#### 1.7 WORK RESTRICTIONS

- A. Comply with Owner's policies regarding face coverings and COVID screenings. Current policy requires face coverings be worn in all parts of the building occupied or used by Owner and that all personnel entering the building be screened by Owner's staff for a body temperature and COVID symptom check. Personnel in areas not occupied or used by Owner are exempt from the mask requirement.
- B. Controlled substances and smoking: Use on Project site is not permitted.

#### 1.8 SPECIFICATION AND DRAWING CONVENTIONS

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

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 10 00





## SECTION 01 22 00 - UNIT PRICES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.

## 1.2 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

## 1.3 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

## 3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1 – Hollow Metal Door Frames.
  - 1. Description: Provide new hollow metal door frames at doors to be Removed and Reinstalled.
  - 2. Unit of Measurement: Dollars per door frame.

END OF SECTION 01 22 00



## SECTION 01 25 00 - SUBSTITUTION PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.

## 1.2 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

## 1.3 ACTION SUBMITTALS

- A. Substitution Requests: Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
  - 1. Documentation:
    - a. State the reason for the substitution.
    - b. Provide coordination information, including changes to other parts of the Work and to construction performed by Owner and separate contractors, that will be caused by the proposed substitution.
    - c. Provide a comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Provide product data, certificates, test reports, and samples where applicable.
    - e. Identify similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
    - f. Quantify the substitution's affect on Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
    - g. Provide cost information, including a proposal of change, if any, in the Contract Sum.
    - h. Certify that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
    - i. Provide a waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
  1. Conditions: Architect will consider Contractor's request for substitution when the requested substitution:
    - a. is consistent with the Contract Documents and will produce indicated results;
    - b. will not adversely affect Contractor's construction schedule;
    - c. has received necessary approvals of authorities having jurisdiction;
    - d. is compatible with other portions of the Work;
    - e. has been coordinated with other portions of the Work;
    - f. provides specified warranty;
    - g. has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

## PART 3 - EXECUTION (Not Used)

END OF SECTION 01 25 00

## SECTION 01 29 00 - PAYMENT PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

## 1.2 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
  - 1. Identification: Include the following Project identification on the schedule of values:
    - a. Project name and location.
    - b. Name of Architect.
    - c. Architect's project number.
    - d. Contractor's name and address.
    - e. Date of submittal.
  - 2. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - 3. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
  - 4. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - 5. Schedule Updating: Update and resubmit the schedule of values before the next Applications For Payment when Change Orders or Construction Change Directives result in a change of the Contract Sum.

## 1.3 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
- B. Payment Application Times: Submit monthly.
- C. Application for Payment Forms: Use the AIA G702 Payment Application.
- D. Application Preparation: Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
- E. Transmittal: Submit Application for Payment to Architect by pdf.
- F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
  - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  - 2. When an application shows completion of an item, submit conditional final or full waivers.
  - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
- G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
  - 1. List of subcontractors.
  - 2. Schedule of values.
  - 3. Contractor's construction schedule (preliminary if not final).
  - 4. Schedule of unit prices.
  - 5. Submittal schedule (preliminary if not final).
  - 6. List of Contractor's staff assignments.
  - 7. List of Contractor's principal consultants.
  - 8. Copies of permits.
  - 9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  - 10. Initial progress report.
  - 11. Report of preconstruction conference.
  - 12. Certificates of insurance and insurance policies.
- H. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.

1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706-1994, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A-1994, "Contractor's Affidavit of Release of Liens."
  6. Evidence that claims have been settled.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 29 00





## SECTION 01 31 00 - PROJECT MANAGEMENT AND COORDINATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. Requests for Information (RFIs).
  - 2. Project meetings.

## 1.2 DEFINITIONS

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

## 1.3 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.

## 1.4 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations to ensure efficient and orderly installation of each part of the Work.
- B. Coordinate with owner's dental equipment vendor. Vendor will be installing existing and new dental equipment, both floor- and wall-mounted. Coordinate locations of underslab utilities, wall blocking, dental services such as power, data, water, gases.

## 1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI.
- B. Content of the RFI:
  - 1. Project name.
  - 2. Date.
  - 3. Name of Contractor.

4. Name of Architect.
  5. RFI number, numbered sequentially.
  6. RFI subject.
  7. Specification Section number and title and related paragraphs, as appropriate.
  8. Drawing number and detail references, as appropriate.
  9. Description of item needing information or interpretation.
  10. Field dimensions and conditions, as appropriate.
  11. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
- C. Architect's Action: Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 4:00 p.m. will be considered as received the following working day.
1. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  2. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
- D. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit at each project meeting. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were dropped and not submitted.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.

## 1.6 MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
1. Attendees: Owner, Architect, Contractor, and other entities concerned with current and upcoming activities shall be invited. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work. Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times.
  2. Agenda:
    - a. Minutes: Review and correct or approve minutes of previous progress meeting.
    - b. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      - 1) Look Ahead: Review schedule for period until next meeting.

- c. Review present and future needs of each entity present, including the following:
  - 1) Safety and security.
  - 2) Interface requirements.
  - 3) Sequence of operations.
  - 4) Status of submittals.
  - 5) Deliveries.
  - 6) Off-site fabrication.
  - 7) Access.
  - 8) Site utilization.
  - 9) Temporary facilities and controls.
  - 10) Owner's use of site.
  - 11) Utility disruptions.
  - 12) Progress cleaning.
  - 13) Quality and work standards.
  - 14) Status of correction of deficient items.
  - 15) Field observations.
  - 16) RFI Log.
  - 17) PCO Log and Change Orders.
  - 18) Pending changes.
  - 19) Status of Change Orders.
  - 20) Pending claims and disputes.
  - 21) Payment requests.
3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 31 00



## SECTION 01 32 00 - CONSTRUCTION PROGRESS DOCUMENTATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Contractor's construction schedule.
  - 2. Construction schedule updating reports.
  - 3. Site condition reports.
  - 4. Periodic construction photographs.

## PART 2 - PRODUCTS

## 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Section 013300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
  - 5. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- D. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  - 1. Unresolved issues.
  - 2. Unanswered Requests for Information.

3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and Contract Time.
- E. Recovery Schedule: When the Work is behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.

## 2.2 REPORTS

- A. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.3 PHOTOGRAPHIC MEDIA

- A. Submit digital photographs of the Work in progress to Architect. Include photographs of wall cavities with services immediately prior to close-up.
- B. Digital Images: Provide images in JPG format, with minimum size of 8 megapixels.

## PART 3 - EXECUTION

### 3.1 PROJECT SCHEDULE

- A. Update with each pay request.

END OF SECTION 01 32 00

## SECTION 01 33 00 - SUBMITTAL PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes requirements for the submittal schedule and administrative and procedural requirements for submittals.
- B. Related Requirements:
  - 1. Section 01 32 00 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 2. Section 01 78 23 "Operation and Maintenance Data" for submitting operation and maintenance manuals.

## 1.2 DEFINITIONS

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

## 1.3 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.

## 1.4 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  - 1. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.

- a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
- D. Submittal Information:
1. Project name.
  2. Date.
  3. Name of Architect.
  4. Name of Contractor.
  5. Name of subcontractor.
  6. Name of supplier.
  7. Name of manufacturer.
  8. Submittal number or other unique identifier, including revision identifier.
    - a. Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).
  9. Number and title of appropriate Specification Section.
  10. Drawing number and detail references, as appropriate.
  11. Location(s) where product is to be installed, as appropriate.
  12. Indication of full or partial submittal.
- E. Options: Identify options requiring selection by Architect.
- F. Deviations: Identify deviations from the Contract Documents on submittals.
- G. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
1. Note date and content of previous submittal.
  2. Note date and content of revision and clearly indicate extent of revision.
  3. Resubmit submittals until they are marked with approval.
- H. Use for Construction: Retain complete copies of submittals on Project site. Use only approved final action submittals.

## PART 2 - PRODUCTS

- A. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.



1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
  - a. Generic description of Sample.
  - b. Product name and name of manufacturer.
  - c. Sample source.
  - d. Number and title of applicable Specification Section.
3. Provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
4. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
5. Samples for Initial Selection: Submit one full set(s) of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.

### PART 3 - EXECUTION

#### 3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 77 00 "Closeout Procedures."
- C. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

#### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.

- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.

END OF SECTION 01 33 00

## SECTION 01 50 00 - TEMPORARY FACILITIES AND CONTROLS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

## 1.2 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

## 1.3 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## 1.4 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.

## PART 2 - PRODUCTS

## 2.1 EQUIPMENT

- A. Fire Extinguishers: Provide portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
  - 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
- C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
- D. Fencing: Provide fencing to secure project site and materials.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

## 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services. Owner's operations preclude interruptions in electric power service
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

- D. Heating: Provide temporary heating required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- E. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- F. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner. Owner's operations preclude interruptions in electric power service.
- G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. Parking: Coordinate use of designated areas of Owner's existing parking areas for construction personnel.
- B. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
  - 1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
  - 2. Remove snow and ice as required to minimize accumulations.
- C. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
  - 1. Temporary Signs: Provide signs as indicated or as required to inform public and individuals seeking entrance to Project.
  - 2. Project Team Signs: Coordinate location of Contractor's and Architect's signs with Architect and Owner. Return Architect's sign to Architect at Substantial Completion.
  - 3. Maintain and touchup signs so they are legible at all times.
- D. Waste Disposal Facilities: Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."
- E. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
  - 1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- F. Existing Elevator Use: Use of elevators is not permitted.
- G. Existing Stair Usage: Use of Owner's existing stairs will be permitted, provided stairs are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore stairs to condition existing before initial use.

1. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

- H. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
- B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
- C. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to requirements of 2003 EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- G. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

### 3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
  - 1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  - 2. Keep interior spaces reasonably clean and protected from water damage.
  - 3. Discard or replace water-damaged and wet material.
  - 4. Discard, replace, or clean stored or installed material that begins to grow mold.
  - 5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
  - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
  - 2. Remove materials that can not be completely restored to their manufactured moisture level within 48 hours.

### 3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
- C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 01 50 00



## SECTION 01 74 19 - CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
  - 1. Salvaging nonhazardous demolition waste.
  - 2. Disposing of nonhazardous demolition and construction waste.
- B. Related Requirements:
  - 1. Section 02 41 19 "Selective Demolition" for disposition of waste resulting from partial demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.

## 1.2 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse by Owner.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
  - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Remove waste materials from Owner's property and legally dispose of them.

END OF SECTION 01 74 19

## SECTION 01 77 00 - CLOSEOUT PROCEDURES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 01 78 23 "Operation and Maintenance Data" for operation and maintenance manual requirements.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

## 1.3 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

## 1.5 SUBSTANTIAL COMPLETION PROCEDURES

- A. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. List of incomplete items (Punch List): Include name and identification of each space and area affected by construction operations for incomplete items and items needing

- correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
- a. Organize list of spaces in sequential order,
  - b. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
2. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  3. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, construction progress photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
    - a. Organize project progress photographs by date taken.
  4. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  5. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Construction Manager. Label with manufacturer's name and model number where applicable.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
  6. Submit test/adjust/balance records.
  7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  8. Submit as-built drawings, paper copy and pdf.
- B. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
  2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  3. Complete startup and testing of systems and equipment.
  4. Perform preventive maintenance on equipment used prior to Substantial Completion.
  5. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
  6. Complete final cleaning requirements, including touchup painting.
  7. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- C. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. On receipt of request, Architect will either proceed with inspection or notify Contractor

of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for final completion.

#### 1.6 FINAL COMPLETION PROCEDURES

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
  1. Submit a final Application for Payment according to Section 012900 "Payment Procedures."
  2. Certified List of Incomplete Items: Submit copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  4. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection to determine acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
  1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

#### 1.7 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.

## PART 2 - PRODUCTS

## 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

## PART 3 - EXECUTION

## 3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Engage a professional cleaner to perform final cleaning.

## 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent fixtures to comply with requirements for new fixtures.

END OF SECTION 01 77 00

## SECTION 01 78 23 - OPERATION AND MAINTENANCE DATA

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Operation and maintenance manuals for systems, subsystems, and equipment.
  - 3. Product maintenance manuals.

## 1.2 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name.
- C. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's comments. Submit one copy of each corrected manual within 15 days of receipt of Architect's comments and prior to commencing demonstration and training.

## PART 2 - PRODUCTS

## 2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.
- B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page.
  - 2. Table of contents.
  - 3. Manual contents.
- C. Title Page: Include the following information:
  - 1. Subject matter included in manual.
  - 2. Name and address of Project.
  - 3. Name and address of Owner.
  - 4. Date of submittal.
  - 5. Name and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 8. Cross-reference to related systems in other operation and maintenance manuals.
- D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

## 2.2 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  - 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
  - 2. Performance and design criteria if Contractor is delegated design responsibility.
  - 3. Operating standards.
  - 4. Operating procedures.



5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
6. Normal shutdown instructions.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

### 2.3 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:

1. Product name and model number.
2. Manufacturer's name.

3. Color, pattern, and texture.
4. Material and chemical composition.
5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:

1. Inspection procedures.
2. Types of cleaning agents to be used and methods of cleaning.
3. List of cleaning agents and methods of cleaning detrimental to product.
4. Schedule for routine cleaning and maintenance.
5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

#### 2.4 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:

1. Standard maintenance instructions and bulletins.
2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
3. Identification and nomenclature of parts and components.
4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:

1. Test and inspection instructions.
2. Troubleshooting guide.
3. Precautions against improper maintenance.
4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
5. Aligning, adjusting, and checking instructions.
6. Demonstration and training video recording, if available.

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 78 23



DOCUMENT 02 26 00 – HAZARDOUS MATERIAL ASSESSMENT

- 1.1 “Hazardous Materials Assessment, Harrington Family Health Center, 50 East Main Street, Harrington, Maine,” July 28, 2020. Report Prepared By: CES, Inc. (now Haley Ward) One Merchants Plaza, Suite 710, Bangor, Maine 04401.



## SECTION 02 41 19 - SELECTIVE DEMOLITION

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Demolition and removal of selected portions of building or structure.
2. Salvage of existing items to be reused or recycled.

## 1.2 REFERENCES

- A. ANSI/ASSE A10.6: Safety & Health Program Requirements for Demolition Operations.
- B. NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations.

## 1.3 DEFINITIONS

- A. Remove (R): Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage (S): Detach items from existing construction in a manner to prevent damage, and deliver to Owner.
- C. Remove and Reinstall (P): Detach items from existing construction in a manner to prevent damage, prepare for reuse, and reinstall where indicated.
- D. Existing to Remain (E): Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

## 1.4 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.

## 1.5 FIELD CONDITIONS

- A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.
- B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
  1. Before selective demolition, Owner will remove the following items:

- a. Loose items.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Storage or sale of removed items or materials on-site is not permitted.

## 1.6 WARRANTY

- A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
  - 1. Arrange to shut off indicated utilities with utility companies.



2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
  1. Comply with requirements for access and protection specified in Section 015000 "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
  1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
  4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  5. Dispose of demolished items and materials promptly. Comply with requirements in Section 017419 "Construction Waste Management and Disposal."
- B. Removed and Salvaged Items:
  1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:

1. Clean and repair items to functional condition adequate for intended reuse.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

E. Scope of Demolition: The project may require Removal, Removal and Salvage, Removal and Reinstallation, and Patching not indicated in Drawings, but necessary to accomplish the Work shown in the Contract Documents.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain on Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
4. Comply with requirements specified in Section 017419 "Construction Waste Management and Disposal."

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

### 3.6 CLEANING

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

END OF SECTION 02 41 19

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

## PART 1 GENERAL

## 1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

## 1.02 DESCRIPTION OF WORK:

- A. Work included: Provide labor, materials, and equipment necessary to complete the work of this Section and, without limiting the generality thereof, furnish and include the following:
  - 1. The extent of cast-in-place concrete work is shown on drawings and includes (but not by way of limitation) formwork, reinforcing, cast-in-place concrete, accessories, finishing, and casting in of items specified under other Sections of the Specifications or furnished by Owner that are required to be built-in with the concrete.
  - 2. Equipment support pads indicated on mechanical drawings to be installed by the Building Contractor.
  - 3. Cast-in-place retaining walls, exterior slabs on grade and other concrete shown on site drawings.

## 1.03 RELATED WORK:

- A. Metal Fabrications: Section 05 50 00
- B. Joint Sealants: Section 07 90 00
- C. Underslab Vapor Retarders/Wall Waterproofing: Division 7

## 1.04 QUALITY ASSURANCE:

- A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:
  - 1. ACI “Manual of Concrete Practice”.
  - 2. ACI 117 “Standard Specifications for Tolerances for Concrete Construction and Materials”.

3. ACI 211.1 "Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete."
4. ACI 212.3R "Chemical Admixtures for Concrete."
5. ACI 301 "Specifications for Structural Concrete for Buildings."
6. ACI 302.1R "Guide for Concrete Floor and Slab Construction."
7. ACI 304R "Guide for Measuring, Mixing, Transporting and Placing Concrete."
8. ACI 304.2R "Placing Concrete by Pumping Methods."
9. ACI 306 R "Cold Weather Concreting."
10. ACI 308 "Standard Practice for Curing Concrete."
11. ACI 309R "Guide for Consolidation of Concrete."
12. ACI 315 "ACI Detailing Manual."
13. ACI 318 "Building Code Requirements for Reinforced Concrete."
14. ACI 347R "Guide to Formwork for Concrete."
15. Concrete Reinforcing Steel Institute, "Placing Reinforcing Bars."
16. AISC "Code of Standard Practice for Steel Buildings and Bridges."
17. "Code of Federal Regulations, Part 1926" per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

B. Materials and installed work may require testing and retesting, as directed by the Architect, at any time during progress of work. Allow free access to material stockpiles and facilities. Tests not specifically indicated to be done at Owner's expense, including retesting of rejected materials and installed work, shall be done at Contractor's expense.

#### 1.05 SUBMITTALS:

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.

- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.
- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- H. Electronic Submittals:
1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
  2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
  3. Electronic Submittals shall be submitted in Protected Document Format (PDF) compatible with Bluebeam version 12 or later. Electronic files shall not be broken into smaller individual files. File sizes too large to process email or within a file transfer protocol (FTP) site shall be provided on a CD.
  4. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
  5. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards).

1. Reinforcement certified mill reports covering chemical and physical properties and yield strength.
2. Patching products.
3. Non-shrink grout.
4. Curing compounds, where applicable.
5. Admixtures.
6. Expansion/Adhesive Anchors.

J. Shop Drawings:

1. Shop Drawing Preparation: Electronic files of structural drawings will not be provided to the contractor for preparation of shop drawings. Reproduction of any portion of the Construction Documents for use as Shop drawings is prohibited. Shop drawings created from reproduced Construction Documents will be returned without review. Submit shop drawings for fabrication, bending and placement of concrete reinforcement. Comply with ACI 315, showing bar schedules, stirrup and tie spacing, diagrams of bent bars, and arrangement of concrete reinforcement. Include special reinforcement required at openings through concrete elements. Include supplemental reinforcing and bar supports necessary to support reinforcing steel at proper location within forms or slabs.
  - a. Review of the shop drawings will be made for the size and arrangement of reinforcement. Conformance of the Shop Drawings to the Contract Drawings remains the responsibility of the General Contractor. Engineer's review in no way relieves the General Contractor of this responsibility.
  - b. Shop drawings will not be reviewed as partial submittals. A complete submittal shall be provided all items listed prior. **Incomplete submittals will not be reviewed.**

K. Mix designs: Submit all laboratory test reports and materials for each mix design listed within. Prepare mixes by the field experience method and/or trial mixtures per the requirements of chapter 5 of ACI 318. Include the calculation of average strength and standard deviation. Proportioning by water cement ratio method will not be permitted.

L. Samples: Submit samples of materials as specified and as otherwise requested by Architect, including names, sources and descriptions.

- M. Hot and Cold Weather Concrete Procedures: Submit a detailed written procedures for placement of concrete at the temperatures anticipated for the project. Include, but not by limitation, subgrade protection and/or heating, production/ready mix methods, transportation and conveying methods, placement, protection, termination of protection, curing and quality control/monitoring procedures. Procedures shall meet the requirements of the latest edition of ACI 305.1 and ACI 306.1 for hot weather and cold weather concreting, respectively.
- N. Curing Methods: Submit documentation of curing methods to be used for review. Account for anticipated project temperature ranges and conditions in curing methods.
- O. Contraction/Construction Joints: Submit plan indicating proposed location of contraction and construction joints in walls and slabs.
- P. Test Reports: Test reports shall be submitted to the Owner, Architect and Engineer within 48 hour after completion of each test.

## PART 2 PRODUCTS

### 2.01 FORM MATERIALS:

- A. Forms for Exposed Finish Concrete: Unless otherwise indicated, construct formwork for exposed concrete surfaces with plywood, metal, metal-framed plywood faced or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings. Provide form material with sufficient thickness to withstand pressure of newly-placed concrete without bow or deflection.
  - 1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood", Class I, Exterior Grade or better, mill-oiled and edge-sealed, with piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Form concrete surfaces which will be unexposed in finished structure with plywood, lumber, metal or other acceptable material. Provide lumber dressed on at least 2 edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

### 2.02 REINFORCING MATERIALS:

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. Provide welded wire fabric in flat sheets.

- C. Supports for Reinforcement: Provide supports for reinforcement including bolsters, chairs, spacers, and other devices for spacing, supporting and fastening reinforcing bars and welded wire fabric in place. Use plastic, wire bar type supports or concrete block supports complying with CRSI recommendations, unless otherwise specified. Wood, clay brick and other unspecified devices are not acceptable.
1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
  2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class I) or stainless steel protected (CRSI, Class 2).

### 2.03 CONCRETE MATERIALS:

- A. Single-Source Supplier: Ready-mix concrete shall be from one supplier unless specific written approval is received from the Structural Engineer.
- B. Portland Cement: ASTM C 150, Type I or Type II, unless otherwise approved Use one brand of cement throughout project, unless otherwise acceptable to Architect.
- C. Normal Weight Aggregates: ASTM C 33. Provide from a single source for exposed concrete. Do not use aggregates containing soluble salts or other substances such as iron sulfides, pyrite, marcasite, or ochre which can cause stains on exposed concrete surfaces.
- D. Light Weight Aggregates: ASTM C 330.
- E. Water: Potable.
- F. Air-Entraining Admixture: ASTM C 260.
- G. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F or Type G containing not more than 1% chloride ions.
- H. Fiber reinforcement shall be Type III Synthetic Virgin Homopolymer Polypropylene Fibers conforming to ASTM C1116. Fiber reinforcing shall be added and distributed prior to incorporation of Super Plasticizer.
- I. Normal range water reducing admixture: ASTM C 494 Type A containing no calcium chloride.
- J. Accelerating Admixture: ASTM C 494, Type C or E.
- K. Air Detraining Admixture: ASTM C494, Type S, Specific Performance Admixture
- L. Blast Furnace Slag: ASTM C989
- M. Fly Ash: ASTM C618, Class C or F



N. Calcium Chloride is not permitted.

2.04 RELATED MATERIALS:

- A. Underslab Vapor Retarder: Provide vapor retarder over prepared sub base. Refer to architectural drawings, geotechnical report and/or division 7 specifications for additional requirements and vapor retarder location.
- B. Non-Shrink Cement-based Grout: Provide grout consisting of pre-measured, prepackaged materials supplied by the manufacturer requiring only the addition of water. Manufacturer's instructions must be printed on the outside of each bag.
1. Non-shrink: No shrinkage (0.0%) and a maximum 4.0% expansion when tested in accordance with ASTM C-827. No shrinkage (0.0%) and a maximum of 0.3% expansion in the hardened state when tested in accordance with CRD-C-621.
  2. Compressive strength: A minimum 28 day compressive strength of 5000 psi when tested in accordance with ASTM C-109.
  3. Setting time: A minimum initial set time of 60 minutes when tested in accordance with ASTM C-191.
  4. Composition: Shall not contain metallic particles or expansive cement.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ANSI/ASTM C 171.
1. Waterproof paper.
  2. Polyethylene film.
  3. Polyethylene-coated burlap.
- E. Liquid Membrane-Forming Curing Compound: Liquid type membrane forming curing compound complying with ASTM C 309, Type I, Class A unless other type acceptable to Architect. Curing compound shall not impair bonding of any material, including floor finishes, to be applied directly to the concrete. Demonstrate the non-impairment prior to use.
- F. Preformed Expansion Joint Formers:
1. Bituminous Fiber Type, ASTM D 1751.
  2. Felt Void, Poly-Styrene Cap with removable top as manufactured by SUPERIOR.
- G. Slab Joint Filler: Multi-component polyurethane sealant (self-leveling type).

H. Waterstops shall be Bentonite/Butyl Rubberbased product. Use in conjunction with manufacturer's approved mastic. Acceptable products include:

1. "Waterstop Rx," by American Colloid Co.
2. "Adeka Ultra Seal MC-2010," by Asahi Denka Koeyo, Kik MN.

2.05 PROPORTIONING AND DESIGN OF MIXES:

A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 318. Use material, including all admixtures, proposed for use on the project. If trial batch method used, use an independent testing facility acceptable to Architect for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Architect.

B. Submit written reports to Architect of each proposed mix for each class of concrete. Do not begin concrete production until mixes have been reviewed by Architect.

C. Proportion design mixes to provide concrete with the following properties:

1. Footings and foundation walls

- a. Strength: 3,500 psi at 28 days.
- b. Aggregate: 3/4"
- c. Design Air Dry Density: 145 pcf Normal Weight
- d. W/C Ratio: 0.55 maximum
- e. Entrained Air: 6% +/- 1.5%
- f. Slump: 4" maximum

2. Interior Slabs on grade ("Rat" Slab):

- a. Strength: 3,000 psi at 28 days
- b. Aggregate: 3/4" minimum, 1 1/2" maximum
- c. Design Air Dry Density: 145 pcf Normal Weight
- d. W/C Ratio: 0.54 maximum
- e. Entrapped Air only (no entrainment), not to exceed 3% at point of discharge
- f. Slump: 4" maximum

3. Exterior Slabs and all other exposed Site Concrete not specified elsewhere:
    - a. Strength: 5,000 psi at 28 days
    - b. Aggregate: 3/4"
    - c. Design Air Dry Density: 145 pcf Normal Weight
    - d. W/C Ratio: 0.40 maximum
    - e. Entrained Air: 6% +/- 1.5%
    - f. Slump: 4" maximum
  4. Add air entraining admixture at manufacturers prescribed rate to result in concrete at point of placement having the above noted air contents.
  5. Additional slump may be achieved by the addition of a mid-range or high-range water reducing admixture. Maximum slump after the addition of admixture shall be 6 or 8 inches for mid-range or high range water reducing admixtures, respectively.
- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor, when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to Owner and as accepted by Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Structural Engineer before using in work.
1. Water may be added at the project only if the maximum specified slump and design mix maximum water/cement ratio is not exceeded.
  2. Additional dosages of superplasticizer should be used when delays occur and required slump has not been maintained. A maximum of two additional dosages will be permitted per ACI 212.3R recommendations.

#### 2.06 CONCRETE MIXING:

- A. Job-Site Mixing will not be permitted.
- B. Ready-Mix Concrete: Must comply with the requirements of ASTM C 94, and as herein specified. Provide batch ticket for each batch discharged and used in work, indicating project name, mix type, mix time and quantity.
  1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C94 may be required by Structural Engineer.

2. When the air temperature is between 85 degrees F. and 90 degrees F., reduce the mixing and delivery time from 1 1/2 hours to 75 minutes, and when the air temperature is above 90 degrees F., reduce the mixing and delivery time to 60 minutes.

### PART 3 EXECUTION

#### 3.01 FORMS:

- A. Design, erect, support, brace and maintain formwork to support vertical and lateral loads that might be applied until such loads can be supported by concrete structure. Construct formwork so concrete members and structures are of correct size, shape, alignment, elevation and position.
- B. Design, construct, erect, maintain, and remove forms for cast-in-place concrete work in compliance with ACI 347.
- C. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.
- D. Construct forms to sizes, shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, dovetail slots, reglets, recesses, and the like to prevent swelling and for easy removal.
- F. Provide temporary openings where interior area of formwork is inaccessible for clean out, for inspection before concrete placement and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- G. Chamfer exposed corners and edges as indicated, using wood, metal, PVC or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.
- H. Form Ties: Factory-fabricated, adjustable-length, removable or snap-off metal form ties, designed to prevent form deflection, and to prevent spalling concrete surfaces upon removal.
  1. Unless otherwise indicated, provide ties for concrete surfaces to be exposed to view in the final condition so portion remaining within concrete after removal is 1" (minimum) inside concrete.

2. Form ties shall not leave holes larger than 1" diameter in concrete surface. Repair holes left by form ties after removal of formwork.
- I. Provision for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- J. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement as required to eliminate mortar leaks and maintain proper alignment.

### 3.02 PLACING REINFORCEMENT:

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars", for details and methods of reinforcement placement and supports, and as herein specified.
  1. Subgrade tolerance shall conform to a tolerance of  $+0/-1 \frac{1}{2}$ ". Base tolerance (fine grading) for slabs shall conform to a tolerance of  $+0''/-\frac{3}{4}$ " in. Confirm compliance of above tolerances with surveyed measurements taken at 20 ft. intervals in each direction.
  2. Concrete reinforcing and/or welded wire fabric shown on structural drawings is provided for structural purposes only; additional reinforcement may be necessary for reinforcing support, the anchorage of structural embedded items, and the anchorage of non-structural embedded items including but not by limitation radiant tubing. This reinforcing is not shown on the structural drawings as it is part of the contractor's means and methods and shall be included at no cost to the Owner.
  3. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
  4. Accurately position, support and secure reinforcement against displacement by formwork, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers and hangers, as required.
  5. Place reinforcement to obtain specified coverage for concrete protection within tolerances of ACI-318. Arrange, space and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
  6. Install welded wire fabric in flat sheets in as long lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

### 3.03 JOINTS:

- A. Construction Joints: Locate and install construction joints, which are not shown on drawings, so as not to impair strength and appearance of the structure, as acceptable to Architect. Submit plan indicating proposed location of construction joints for review prior to beginning work.
1. Provide keyways at least 1-1/2" deep in construction joints in walls, and slabs; bulkheads reviewed by the Engineer, designed for this purpose may be used for slabs.
  2. Roughened surfaces shall be used between walls and footings unless shown otherwise on the drawings. The footing surface shall be roughened to at least an amplitude of 1/4" for the width of the wall before placing the wall concrete.
  3. Place construction joints perpendicular to the main reinforcement. Continue reinforcement across construction joints.
  4. Joints in slabs on grade shall be located and detailed as indicated on the drawings. If saw-cut joints are required, the early-entry dry-cut process shall be used. Refer to ACI 302, section 8.3.12.

#### 3.04 INSTALLATION OF EMBEDDED ITEMS:

- A. General: Set, securely anchor and build into work prior to concrete placement all anchorage devices and all other embedded items, including but not by limitation reinforcement, reinforcing dowels, embedded plates, anchor rods, anchor inserts, sleeves, load transfer plates, diamond dowels and shelf bulk heads required for other work that is attached to, bear upon, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions and directions provided by suppliers of items to be attached thereto. Notify other trades to permit installation of their work. Templates to be utilized for setting of anchorage devices shall be constructed in a manner to allow mechanical consolidation of concrete without disturbance. Embedments shall be placed in a timely fashion to permit the inspection of embedments prior to concrete placement. **“Wet Setting” of embedded items into plastic concrete is strictly prohibited.**
- B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface.
- C. Provide PVC sleeves where pipes and/or conduit pass through exterior concrete or slabs. Sleeves or penetrations shall not be placed through footings, piers, pedestals, drop caps, columns or pilasters unless specifically noted.
- D. Tolerances: Tolerances for Anchor Bolts/Rods, other embedded items and bearing surfaces shall meet the requirement set forth in the latest edition of the American Institute of Steel Construction “Code of Standard Practice for Steel Buildings and Bridges,” and ACI 117. The more stringent criteria from these documents shall apply.

#### 3.05 INSTALLATION OF GROUT

- A. Place grout for base plates in accordance with manufacturer's recommendations.

- B. Grout below setting plates as soon as practicable to facilitate erection of steel and prior to removal of temporary bracing and guys. If leveling bolts or shims are used for erection grout shall be installed prior to addition of any column load.
- C. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials and allow to cure. For proprietary grout materials, comply with manufacturer's instructions.

### 3.06 PREPARATION OF FORM SURFACES:

- A. Coat contact surfaces of forms with a form-coating compound before reinforcement is placed.
- B. Thin form-coating compounds only with thinning agent of type, and in amount, and under conditions of form-coating material manufacturer's directions. Do not allow excess form coating to accumulate in forms or to come into contact with concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.

### 3.07 CONCRETE PLACEMENT:

- A. Preplacement Review: Footing bottoms are subject to review by the Geotechnical Engineer. Reinforcement and all concrete preparation work shall be subject to review by the Structural Engineer. Verify that reinforcing, ducts, anchors, seats, plates and other items cast into concrete are placed and securely held. Notify Engineer 48 hours prior to scheduled placement and obtain approval or waiver of review prior to placement. Be sure that all debris and foreign matter is removed from forms.
- B. Concrete shall be placed in the presence of an approved testing agency.
- C. General: Comply with ACI 304, and as herein specified.
  - 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation due to rehandling or flowing.
  - 2. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredients and in a manner which will assure that the required quality of the concrete is maintained.
  - 3. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operations shall conform to the following additional requirements:

- a. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.
  - b. Chutes shall be metal or metal-lined and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long, and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
  - c. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete.
  - d. Concrete shall not be conveyed through pipe made of aluminum alloy. Standby equipment shall be provided on the site.
  - e. Tined rakes are prohibited as a means of conveying fiber reinforced concrete.
4. Do not use reinforcement as bases for runways for concrete conveying equipment or other construction loads.
- D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 18 inches and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
1. Consolidate placed concrete by mechanical vibrating equipment. Hand-spading, rodding or tamping as the sole means for the consolidation of concrete will only be permitted with special permission from the Engineer. Use equipment and procedures for consolidation of concrete in accordance with ACI recommended practices.
  2. Use vibrators designed to operate with vibratory equipment submerged in concrete, maintaining a speed of not less than 8000 impulses per minute and of sufficient amplitude to consolidate the concrete effectively. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine, generally at points 18 inches maximum apart. Place vibrators to rapidly penetrate placed layer and at least 6 inches into the preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion maintain the duration of vibration for the time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operation.



- E. **Placing Concrete Slabs:** Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
1. Consolidate concrete using internal vibrators during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Bring slab surfaces to correct level with straightedge and strike off. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Do not sprinkle water on plastic surface.
  3. Maintain reinforcing in proper position during concrete placement operations.
  4. Slab thicknesses indicated on the drawings are minimums. Provide sufficient concrete to account for structure deflection, subgrade fluctuations, and to obtain the specified slab elevation at the flatness and levelness indicated here within.
  5. Finish: See “Monolithic Slab Finishes” in this specification for slab finish requirements.
- F. **Cold Weather Placing:** Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
1. When air temperature has fallen to or is expected to fall below 40 degrees F (4 degrees C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 degrees F (10 degrees C), and not more than 80 degrees F (27degrees C) at point of placement.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
  3. Do not use calcium chloride, salt and other materials containing antifreeze agents or chemical accelerators.
  4. All temporary heat, form insulation, insulated blankets, coverings, hay or other equipment and materials necessary to protect the concrete work from physical damage caused by frost , freezing action, or low temperature shall be provided prior to start of placing operations.
  5. When the air temperature has fallen to or is expected to fall below 40 degrees F, provide adequate means to maintain the temperature in the area where concrete is being placed between 50 and 70 degrees F.
- G. **Hot Weather Placing:** When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 degrees F. Mixing water may be chilled, or chopped ice may be used to control the concrete temperature provided the water equivalent of the ice is calculated to the total amount of mixing water.
2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that the steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
3. Wet forms thoroughly before placing concrete.
4. Do not use retarding admixtures without the written acceptance by the Architect.

### 3.08 FINISH OF FORMED SURFACES:

- A. Rough Form Finish: For formed concrete surfaces not exposed-to-view in the finish work or by other construction, unless otherwise indicated. This concrete surface shall have texture imparted by form facing material, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4 in. in height rubbed down or chipped off.
- B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, damp-proofing, painting or other similar system. This as-cast concrete surface shall be obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed.
- C. Grout Cleaned Finish: Provide grout cleaned finish to scheduled concrete surfaces which have received smooth form finish treatment. Combine one part Portland cement to 1-1/2 parts fine sand by volume and mix with water to consistency of thick paint. Proprietary additives may be used at Contractor's option. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will closely match adjacent surfaces.
  1. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
- D. Related Unformed Surfaces: At tops of walls and grade beams, horizontal offset surfaces occurring adjacent to formed surfaces, strike-off, smooth and finish with a texture matching adjacent unformed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.09 FLOOR FLATNESS AND LEVELNESS

- A. Floor flatness/levelness tolerances: Tolerances for various floor uses shall conform to the requirements set forth in ACI 117 and ACI 302 for "flat" floor profile.

B. Levelness criteria shall be applied to slabs-on-grade only.

### 3.10 MONOLITHIC SLAB FINISHES:

A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds, and as otherwise indicated.

1. After placing slabs, plane surface to a tolerance not exceeding 1/2 in. in 10 ft. when tested with a 10-ft. straightedge. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms or rakes.

B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, and as otherwise indicated.

C. Trowel Finish: Apply trowel finish to monolithic slab surfaces indicated, including slab surfaces to be covered with carpet, resilient flooring, paint or other thin-film finish coating system.

D. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps and ramps, and elsewhere as indicated.

E. Slab finishes for floor coverings not indicated or exposed to view in the final condition shall be coordinated with the Architect prior to slab placement.

F. Slab Joints: Where indicated, sawn slab contraction joints shall be "soft cut", immediately after concrete surface is firm enough not to be torn or damaged by the blade.

### 3.11 CONCRETE CURING AND PROTECTION:

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with the requirements of ACI 308 as herein specified.

B. Curing Methods: Perform curing of concrete by moist curing, by moisture-retaining cover curing, by curing compound, and by combinations thereof, as herein specified unless noted otherwise. Curing shall commence as soon as concrete surfaces are sufficiently hard as to withstand surface damage.

C. Curing of Slabs-on Grade:

1. Slabs-on-grade shall be cured by wet curing methods unless otherwise noted.
2. Slabs-on-grade to receive floor coverings with moisture sensitive adhesives shall be cured by means of a moisture retaining covering. Coordinate curing with flooring adhesive manufacturer and flooring installer. Submit curing methods to Architect for review and approval.

3. Slab-on Grade with Barrier 1 Admixture shall be cured by means of a moisture retaining covering in accordance with recommendations of Barrier 1 Admixture Manufacturer.

- D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- E. Protection From Mechanical Injury: During the curing period and duration of construction, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to overstress the concrete.

### 3.12 REMOVAL OF FORMS:

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 degrees F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.
- B. Formwork supporting weight of concrete, such as joints, slabs and other structural elements, may not be removed in fewer than 14 days or until concrete has attained design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.
- C. Form facing material may be removed 4 days after placement only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and support.

### 3.13 REUSE OF FORMS:

- A. Clean and repair surfaces of forms to be reused in work. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and latency, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Architect.

### 3.14 MISCELLANEOUS CONCRETE ITEMS:

- A. Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.

### 3.15 CONCRETE SURFACE REPAIRS:

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to the Architect.
  - 1. Cut out honeycomb, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts, down to solid concrete but in no case to a depth of less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush coat the area to be patched with approved bonding agent. Place patching mortar after bonding compound has dried.
  - 2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match color surrounding. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Architect. Surface defects, as such, include color and texture irregularities, form tie holes, cracks, spalls, air bubbles, honeycomb, rock pockets, fins, and other projections on surface and stains and other discolorations that cannot be removed by cleaning.

### 3.16 QUALITY CONTROL TESTING DURING CONSTRUCTION:

- A. Testing Agency shall verify reinforcement, including foundation reinforcement and slab reinforcement (WWF or reinforcing bar). Agent shall verify WWF or reinforcement has been chair/placed with proper clearances.
- B. The Owner shall employ a Testing Laboratory to inspect, sample and test the materials and the production of concrete and to submit test reports. Concrete testing shall be performed by technicians certified by the Maine Concrete Technician Certification Board and/or ACI Concrete Field Testing Technician Grade I.
- C. Concrete shall be sampled and tested for quality control during placement. Quality control testing shall include the following, unless otherwise directed by the Architect.
- D. See Submittals section for report requirements.
- E. Sampling Fresh Concrete: ASTM C 172.

1. Slump: ASTM C143; ne test for each set of compressive strength test specimens. Sample shall be taken from middle third of the load per ASTM C172. A slump test must be run prior to the incorporation of the CFP fibers per recommendations of ACI 544. A slump test must be run prior to and following the addition of a water reducer (superplasticizer) per recommendations of ACI 301.
  2. Air Content: ASTM C231 "Pressure method for normal weight concrete." test for each set of compressive strength specimens measured at point of discharge.
  3. Concrete Temperature: Per ASTM C-1064; One test each time a set of compression test specimens are made.
  4. Compression Test Specimen: ASTM C31; one set of 5 standard cylinders for each compressive strength test, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.
    - a. An insulated Cure Box for specimen curing shall be supplied by Testing Agency for initial curing as defined in ACI C31.
    - b. Means of heating or cooling the Cure Box shall be provided by the Inspection Agency if required in order to maintain a temperature between 60 and 80 degrees F. Contractor shall provide an electrical source to the Testing Agency when required for temperature control.
    - c. A maximum-minimum thermometer shall be provided in the Cure Box by the Testing Agency to record the temperature range of the Cure Box during specimen curing. The Testing Agency shall record the maximum/minimum temperature of the Cure Box when transferring the specimens to the laboratory.
    - d. Test Specimens shall be moist cured.
    - e. Refer to ASTM C31 for additional requirements for Test Specimens.
  5. Compressive Strength Tests: ASTM C39; one set for each 50 cu. yds. or fraction thereof, of each concrete class placed in any one day or for each 4,000 sq. ft. of surface area placed; 1 specimen tested at 7 days, 3 specimens tested at 28 days, 1 specimen retained in reserve for later testing if required.
  6. Pumped concrete shall be tested at point of discharge per ACI 301.
- F. Additional Tests: The testing service will make additional tests of in-place concrete when test results indicate specified concrete strengths and other characteristics have not been attained in the structure, as directed by the Architect. Testing service may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42, or by other methods, as directed. Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

**END OF SECTION**

## SECTION 05 73 00 - METAL RAILINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Stainless Steel Tube railings.
  - 2. Steel Tube railings.
  - 3. Handrail brackets.
- B. Related Sections:
  - 1. Section 061000 "Rough Carpentry" for exterior stairs and railings.
  - 2. Section 062023 "Interior Finish Carpentry" for interior stairs and railings.
  - 3. Section 099113 "Painting."

## 1.2 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Manufacturer's product lines of railings assembled from standard components.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
- C. Calculations: Sealed by a qualified professional engineer.
- D. Samples: For each type of exposed finish required.

## 1.3 QUALITY ASSURANCE

## 1.4 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code-Steel."
- B. Regulatory Requirements: Comply with Department of Justice 2010 ADA Standards for Accessible Design and with code provisions as adopted by authorities having jurisdiction.
  - 1. Handrails: Provide handrails as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to the following:
    - a. Size and Spacing of Handrails:
      - 1) Handrail Diameter: 1-1/4 to 1-1/2 inches.
      - 2) Space between Wall and Rails: 2-1/4 inches minimum.
      - 3) Either round ends of handrails or return ends of handrails smoothly to floor, wall or post.
      - 4) Handrails shall not rotate within their fittings.
    - b. Locations of Handrails:

- 1) Provide handrails at both sides of stairs.
- 2) Mount the top of handrail gripping surface between 34 and 38 inches above stair nosing or ramp surface.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design stairs and railings.
- B. Structural Performance of Railings: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ft. (0.73 kN/m) applied in any direction.
    - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  2. Infill of Guards:
    - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
    - b. Infill load and other loads need not be assumed to act concurrently.

### 2.2 METALS, GENERAL

- A. Brackets, Flanges, and Anchors: Same metal and finish as supported rails unless otherwise indicated.

### 2.3 STEEL FOR PAINTED FINISH

- A. Tubing: ASTM A 500 Grade B.
- B. Sheet, Strip, Plate, and Flat Bar: ASTM A 36
- C. Bars and Shapes: ASTM A 36

### 2.4 HANDRAIL BRACKETS

- A. For connection to pipe: Fabricated from A36 sheet and bar.
- B. For connection to walls: Stamped steel bracket fabricated from .250 coil steel.



## 2.5 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Connections: Fabricate railings with welded connections unless otherwise indicated.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 1. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: used in areas where it is not subject to view, as in service stairs.
- D. Form changes in direction by inserting prefabricated elbow fittings.
- E. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- F. Close exposed ends of hollow railing members with prefabricated end fittings.
- G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
- H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  - 1. Set posts plumb within a tolerance of 1/16 inch in 3 feet (2 mm in 1 m).
  - 2. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet (5 mm in 3 m).
- B. Anchor posts to metal surfaces as indicated using fittings designed and engineered for this purpose.
- C. Attach handrails to walls with wall brackets.
  - 1. Use type of bracket with predrilled hole for exposed bolt anchorage.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.
3. For wood stud partitions, use hanger or lag bolts set into wood backing between studs.
4. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs.

END OF SECTION 05 73 00

## 06 10 00 ROUGH CARPENTRY

## PART 1 GENERAL

## 1.01 RELATED DOCUMENTS

- A. The drawings and general conditions of the contract including General and Supplementary Conditions and other Division 1 Specification sections apply to work of this section.
- B. Examine all other sections of the Specifications for requirements which affect work of this Section whether or not such work is specifically mentioned in this Section.
- C. Coordinate work with that of all trades affecting or affected by work of this Section. Cooperate with such trades to assure the steady progress of all work under the Contract.

## 1.02 DESCRIPTION OF WORK:

- A. Work Included: Provide labor, materials, and equipment necessary to complete the work of this Section, and without limiting the generality thereof furnish and install the following:
  - 1. Wood framing, including joists, rafters, outriggers, scab-ons, headers, stringers, posts, studs, plates, truss bracing and similar members.
  - 2. Wood grounds, nailers, blocking and sleepers.
  - 3. Wood furring.
  - 4. Floor, roof and wall sheathing and underlayment.
  - 5. Miscellaneous carpentry as indicated or required and not specified under other Sections of the Specifications.
  - 6. Fasteners and accessories as indicated and required for rough carpentry.
  - 7. Treated wood as specified.
- B. Related Work Specified Elsewhere:
  - 1. Finish carpentry: Section 06 20 00.
  - 2. Metal studs: Section 05 40 00.
  - 3. Gypsum wall sheathing: Section 09 25 00.
  - 4. Underlayments: Division 7

5. Furnishing and installing of doors and frames: Division 8.

1.03 QUALITY ASSURANCE:

A. Codes and Standards: Comply with provisions of the latest edition of the following except where more stringent requirements are shown or specified:

1. International Building Code, 2015 Edition – International Code Council
2. ANSI/AF&PA (American Forest & Paper Association) – NDS National Design Specification for Wood Construction – Latest Edition
3. AHA (American Hardboard Association) A135.4 – Basic Hardboard.
4. ALSC (American Lumber Standards Committee) – Softwood Lumber Standards.
5. ANSI A208.1 – Mat-Formed Wood Particleboard.
6. APA (American Plywood Association).
7. AWPA (American Wood Preservers Association) C1-All Timber Products – Preservative Treatment by Pressure Process.
8. AWPA (American Wood Preservers Association) C20-Structural Lumber Fire Retardant Treatment by Pressure Process.
9. NELMA (New England Lumber Manufacturer’s Association).
10. NLGA (National Lumber Grades Authority)
11. NIST (National Institute of Standards and Technology, U. S. Department of Commerce [DOC])
12. NFPA (National Forest Products Association)
13. NFPA (National Fire Protection Association)
14. SPIB (Southern Pine Inspection Bureau).
15. WCLIB (West Coast Lumber Inspection Bureau).
16. WWPA (Western Wood Products Association).
17. “Code of Federal Regulations, Part 1926” per the Occupational Safety and Health Administration (OSHA), Department of Labor (Latest Revision).

- B. Lumber shall be supplied in accordance with the following agencies:
1. Lumber Grading Agency: Certified by NLGA for structural framing.
  2. Sheathing Grading Agency: Certified by APA or ICBO approved certification agency. For non-APA rated plywood, provide ICC ES Evaluation report.
  3. Grading stamp shall be on lumber and plywood.
  4. Submit manufacturer's certificate certifying that products meet or exceed specified requirements.
- C. Panelized/Prefabrication plant inspection: Prefabrication plant is subject to plant inspection completed by the Engineer-of-Record or an approved Third-Party Inspection Agency. Inspections shall be performed at the Contractor's expense. Plant inspection does not relieve the Contractor of the obligation to perform work in accordance with the Construction Documents or from implementing their own shop and field quality control program.

#### 1.04 SUBMITTALS

- A. Unless otherwise specified, submittals required in this section shall be submitted for review. Submittals shall be prepared and submitted in accordance with Division 1.
- B. General Contractor shall submit a Submittal Schedule to the engineer within 30 days after they have received the Owner's Notice to Proceed.
- C. All submittals shall be reviewed and returned to the Architect within 10 working days.
- D. Incomplete submittals will not be reviewed.
- E. Submittals not reviewed by the General Contractor prior to submission to the Engineer will not be reviewed. Include on the submittal statement or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in sections Division 1 have been complied with.
- F. Engineer will review submittals a maximum of two review cycles as part of their normal services. If submittals are incomplete or otherwise unacceptable and re-submitted, General Contractor shall compensate Engineer for additional review cycles.

- G. Hardcopy Submittals: Submit three prints. Prints will be reviewed by the Engineer, and then the Architect. One marked print will be returned to Contractor for printing and distribution. Multiple copies will not be marked by the Engineer.
- H. Electronic Submittals:
1. Contractor shall include in the submittal schedule an indication of submittals that are intended to be submitted electronically. Upon receipt of the submittal schedule, the Engineer reserves the right to indicate submittals that will not be accepted electronically. Paper copies of such submittals shall be furnished as referenced in this specification.
  2. The Engineer reserves the right to require paper copies of submittals that are received electronically. Provide Engineer one (1) paper copies in addition to the electronic submittal. Paper copy will be retained and electronic copy will be returned. Review cycle for such submittals shall not commence until such time that the paper copies are received.
  3. The submission of submittals electronically does not relieve the contractor of their responsibility to review the submittal prior to transmission to the Engineer. Electronic Submittals shall include contractor comments, and a statement and/or stamp of approval by Contractor, representing that the Contractor has seen and examined the submittal and that all requirements listed in this Section and Division 1 have been complied with. Electronic submittals without the Contractor's approval will be rejected and returned.
  4. The Engineer assumes no responsibility for the printed reproduction of submittals reviewed electronically, transmission errors or returned electronic submittals that become corrupted or are otherwise not accessible by the Contractor's or Subcontractor's computer hardware and/or software.
- I. Product Data: Submit producer's or manufacturer's specifications and installation instructions for the following products. Include laboratory test reports and other data to show compliance with specifications (including specified standards). Product data shall include ICC/ICBO Evaluation Reports indicating conformance to standards specified here within.
1. Engineered Wood Products
  2. Pressure Treated Lumber
  3. Sheathing
  4. Samples of Exposed to View Wood Members: Submit two samples, 6 inches long,

illustrating wood grain, stain, and finish.

5. Hangers, Hardware and Accessories

1.05 DELIVERY, STORAGE, AND PROTECTION

- A. Protect materials from warping or other distortion by stacking to resist movement.
- B. Follow manufacturer's recommendations for storage of Engineered Wood Products and connection hardware.

PART 2 PRODUCTS

2.01 LUMBER MATERIALS

- A. Lumber, General: Factory-mark each piece of lumber with type, grade, mill and grading agency, except omit marking from surfaces to be exposed with transparent finish or without finish.
- B. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20, for moisture content specified for each use.
  - 1. Provide dressed lumber, S4S, unless otherwise indicated.
  - 2. Provide seasoned lumber with 19% maximum moisture content at time of dressing.
- C. For structural framing (4" and wider and from 2" to 4" thick), provide the following grade and species:
  - 1. Spruce-Pine-Fir (SPF) #1/2 or better, NLGA Graded, unless noted otherwise on Structural Drawings, Minimum Design Stresses:

- a. Fb: 875 psi
- b. Ft: 450 psi
- c. Fv: 135 psi
- d. Fc $\perp$ : 425 psi
- e. Fc: 1,150 psi
- f. E: 1,400,000 psi

2. Pressure treated lumber: Southern Yellow Pine #2 or better. Minimum Design Stresses:

- a. Fb: 1,300 psi
- b. Ft: 775 psi
- c. Fv: 175 psi
- d. Fc $\perp$ : 565 psi
- e. Fc: 1,650 psi
- f. E: 1,400,000 psi

3. See structural drawings for grades and bending stress at specific locations.

D. Miscellaneous Lumber: Provide wood for support or attachment of other work including cant strips, bucks, nails, blocking, furring, grounds, stripping and similar members. Provide lumber of sizes indicated, worked into shapes shown, and as follows:

1. Moisture content: 19% maximum for lumber items not specified to receive wood preservative treatment.
2. Grade: Construction Grade light framing size lumber of any species or board size lumber as required. Provide construction grade boards (NELMA, NLGA or WCLB) or No.2 boards (SPIB, NLGA, NELMA, or WWPA).

## 2.02 SHEATHING LOCATIONS

- A. Roof Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 5/8 inch thick, 48 x 96 inch sized sheets, square edges, unless noted. Provide H-clips per the manufacturer's recommendations.
- B. Floor Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 3/4 inch thick, 48 x 96 inch sized sheets, tongue and groove.



- C. Wall Sheathing: NIST/DOC PS-1 or PS-2 rated, Exposure 1, 1/2 inch thick, 48 x 96 inch sized sheets, square edges.
- D. Thicknesses indicated are nominal.
- E. Sheathing shall be stamped with grading agency stamp
- F. Backing Panels: For mounting electrical or telephone equipment, provide fire-retardant-treated plywood panels where required per Code requirements. Paint as required by electrical code.

### 2.03 ENGINEERED WOOD PRODUCTS

- A. General: Provide engineered wood products acceptable to authorities having jurisdiction and for which, current model code research or evaluation reports exist that evidence compliance with building code in effect for Project. Provide depths and widths as indicated.
  - 1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis, and demonstrated by comprehensive testing performed by a qualified independent testing agency.
  - 2. Source and Species: Unless otherwise indicated, lumber sources in Engineered Wood Products shall be of single source and species.
  - 3. Adhesives shall be exterior type, complying with ASTM D2559.
  - 4. Substitutions: Substitutions of Engineered Wood Products other than those specified will be permitted only with written certification from the manufacturer that the substituted items "meets or exceeds" all properties of the specified product, including engineering, serviceability, aesthetic and durability characteristics. Substitutions shall not be made without written approval of the Architect and Engineer.
- B. Laminated-Veneer Lumber (LVL): Lumber manufactured by laminating wood veneers in a continuous press using an exterior-type adhesive complying with ASTM D 2559 to produce members with grain of veneers parallel to their lengths and complying with the following requirements:
 

Boise Cascade	$F_b = 3080 \text{ psi}, E = 2.0 \times 10^6$
I-Level:	$F_b = 2600 \text{ psi}, E = 1.9 \times 10^6$
- C. Parallel-Strand Lumber (PSL): Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with grain of strands parallel to their lengths and complying with the following requirements:

I-Level :  $F_{cII} = 2,900 \text{ psi}$ ,  $F_b = 2900 \text{ psi}$ ,  $E = 2.0 \times 10^6$

- D. I-Joists: Meet manufacturer's standards for all properties and stiffness, for I-Joist series indicated.

Boise Cascade: BCI Series, as indicated on the drawings

I-Level: TJI Series, as indicated on the drawings

- E. Laminated Strand Lumber (LSL): Lumber manufactured by laying up wood strands using an exterior-type adhesive complying with ASTM D 2559, and cured under pressure to produce members with laminations of strands parallel to their lengths and complying with the following requirements:

I-Level:  $F_b = 1,700 \text{ psi}$ ,  $E = 1.3 \times 10^6$  (depths to 8 5/8")  
 $F_b = 1,700 \text{ psi}$ ,  $E = 1.7 \times 10^6$  (depth 9 1/4" and up)

## 2.04 ACCESSORIES

- A. Fasteners, Anchors, Connectors and Hardware:

1. Fasteners (for wood framing): Nail fasteners shall meet requirements of ASTM F1667. Unless noted otherwise, nails referenced on drawings are to be Common Nails with dimensions as follows:
  - a. 6d: 2" long by 0.113" diameter shank with 0.266" diameter head
  - b. 8d: 2 1/2" long by 0.131" diameter shank with 0.281" diameter head
  - c. 10d: 3" long by 0.148" diameter shank with 0.312" diameter head
  - d. 12d: 3 1/4" long by 0.148" diameter shank with 0.312" diameter head
  - e. 16d: 3 1/2" long by 0.162" diameter shank with 0.344" diameter head
  - f. 20d: 4" long by 0.192" diameter shank with 0.406" diameter head
  - g. 30d: 4 1/2" long by 0.207" diameter shank with 0.438" diameter head
2. Anchor Bolts: ASTM A307 headed and SSTB Anchor Bolts by Simpson StrongTie, unless noted otherwise. "J" or "L" type anchor bolts shall not be substituted.
3. Screw fasteners (where indicated on drawings or required to install connection hardware):
  - a. SD & SDS Screws by Simpson Strong Tie

- b. RSS Screws by GRK Fasteners, (800) 263-0463
  - c. Timberlok Screws by Fasten Master.
  - d. Wood Screws: ANSI/ASME Standard B18.6.1
4. Lag Screws: ANSI/ASME Standard B18.2.1. Provide lead hole per NDS Chapter 11.
5. Through Bolts: ANSI/ASME Standard B18.2.1:
- a. Holes for through bolts shall be a minimum of 1/32nd and a maximum of 1/16th larger than bolt diameter.
  - b. A standard cut washer shall be provided between the wood and bolt head, and wood and nut, unless noted otherwise.
- B. Structural Framing Connectors, Hardware or Joist Hangers: As indicated on the drawings or sized to suit framing conditions, manufactured by Simpson or approved alternate.
- 1. Unless noted, fill all nail holes to achieve manufacturer's maximum reaction rating.
  - 2. Use nail diameter and length as specified by connector manufacturer. Substitutions of pneumatic nails or "joist hanger" (non standard length) nails shall not be made without written authorization of the Engineer.
- C. Construction Adhesive: APA AFG-01, approved for use with type of construction panel indicated by both adhesive and panel manufacturer.
- D. ALL ANCHORS, CONNECTORS AND FASTENERS IN CONTACT WITH PRESSURE TREATED LUMBER, AND/OR AT EXTERIOR EXPOSURE SHALL HAVE COATINGS AS FOLLOWS, UNLESS NOTED OTHERWISE:
- 1. Anchor Bolts/Bolts/Lag Bolts: Hot Dipped Galvanized, ASTM A123
  - 2. Connection Hardware, unless otherwise noted: Simpson Strongtie Stainless Steel Z-Max (G185 per ASTM A653) or Hot Dipped Galvanized (HDG, ASTM A123). Use hot dipped galvanized fasteners, ASTM A153 with these hangers.
  - 3. Nails and Fasteners, unless otherwise noted: Hot Dipped Galvanized, ASTM A153.
  - 4. Proprietary coatings used in conjunction with pressure treated fastener coatings will be permitted with written permission from the Architect and Engineer.

## 2.05 FACTORY WOOD TREATMENT

### A. PRESSURE TREATED LUMBER (P. T.)

1. Wood Preservative (Pressure Treatment): AWWPA Treatment, ACQ-C (amine formulated), ACQ-D or CA-B, ammonia free.
2. The use of ACZA and CCA treated lumber is strictly prohibited.
3. Retention:
  - a. Above Ground Use: ACQ: 0.25 pcf, CA-B: 0.10 pcf
  - b. Ground Contact Use: ACQ: 0.40 pcf, CA-B: 0.21 pcf.
4. See Section the “Fasteners, Anchors, Connectors and Hardware” portion of this specification for fastener, anchor and hardware requirements for use with pressure treated lumber.
5. Pressure treated lumber shall not contain ammonia unless authorized by the Architect and Engineer. Ammonia content shall be verified with the Pressure Treatment manufacturer.

### PART 3 EXECUTION

#### 3.01 FRAMING

- A. Set members level and plumb, in correct position.
- B. Unless noted otherwise, wall top plates shall be doubled. Install top plates with overlapping corners and at intersections with adjoining partitions. End joints in double top plates shall be offset at least 48 inches.
- C. Make provisions for erection loads, and for sufficient temporary bracing to maintain structure safe, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- D. Place horizontal members, crown side up.
- E. Construct load bearing framing members full length without splices.
- F. Double members at openings over 24 inches wide and as indicated. Space short studs over and under opening to stud spacing.
- G. Double joists under partitions that run parallel to joist framing.
- H. Posts and columns shall be blocked at floor and/or roof levels with framing matching or exceeding post dimensions down to supporting foundation.
- I. Place sill gasket directly on cementitious foundation. Puncture gasket clean and fit tight to

protruding foundation anchor bolts.

- J. Coordinate installation of wood decking, joist members, rafter members and/or prefabricated wood trusses.
- K. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.
- L. Coordinate curb installation with installation of decking and support of deck openings, and roofing vapor retardant.
- M. Rough Carpentry Fastening Schedule: Unless otherwise indicated on the drawings, provide minimum nailing and fastening per IBC Table 2304.9.1.

### 3.02 SHEATHING

- A. Secure roof sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing provide gap between panels as recommended by manufacturer. Utilize H-clips at panel edges per manufacturer's recommendations or as indicated. Provide blocking where indicated on the Drawings.
- B. Secure floor sheathing with longer edge perpendicular to framing members and with ends staggered and sheet ends over bearing. Secure tongue in groove per manufacturers instructions. Glue and nail/screw as indicated. Provide blocking where indicated on the Drawings. Floor sheathing shall be laid out in a manner to prevent squeaks.
- C. Secure wall sheathing with long dimension perpendicular to wall studs, with ends over firm bearing and staggered.
- D. Install telephone and electrical panel backboards with plywood sheathing material where required. Size as indicated, 6 inch larger than panel space required or per local Code requirements.

### 3.03 TOLERANCES

- A. Framing Members: 1/4 inch from true position, maximum.
- B. Fasteners Driving Tolerance: Unless noted otherwise, fastener heads shall be driven flush with attached framing member or sheathing. Maximum indentation tolerance from flush shall be 1/16 inch.

**END OF SECTION**



## SECTION 06 20 13 - EXTERIOR FINISH CARPENTRY

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Exterior cellular PVC trim and soffits.
  - 2. Exterior stairs and railings.
- B. Related Requirements:
  - 1. Section 057300 "Metal Railings."
  - 2. Section 074600 "Siding."
  - 3. Section 079200 "Joint Sealants."

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product.
- B. Samples: For each type of product involving selection of colors, profiles, or textures.

## PART 2 - PRODUCTS

## 2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated.
- B. Factory mark each piece of lumber with grade stamp of inspection agency, indicating grade, species, moisture content at time of surfacing, and mill.
  - 1. For exposed lumber, mark grade stamp on end or back of each piece.
- C. Softwood Plywood: DOC PS 1.
- D. Hardboard: ANSI A135.4.

## 2.2 EXTERIOR CELLULAR PVC TRIM AND SOFFITS

- A. Subject to compliance with requirements, products which may be incorporated into the project include, but are not limited to the following:
  - 1. Royal S4S Trimboard extruded, expanded PVC with a small-cell microstructure, recommended by manufacturer for exterior use, made from UV- and heat-stabilized rigid material.
  - 2. Azek Sheet.
  - 3. Azek vented soffit.

- B. Density: Not less than 31 lb/cu. ft. (500 kg/cu. m).
- C. Heat Deflection Temperature: Not less than 130 deg F (54 deg C), according to ASTM D 648.
- D. Water Absorption: Not more than 1 percent, according to ASTM D 570.
- E. Flame-Spread Index: 75 or less, according to ASTM E 84.

## 2.3 EXTERIOR STAIRS

- A. Stairs:
  - 1. Treads: 1-1/4-inch (32-mm) thick, kiln-dried, pressure-preservative-treated stepping with half-round or rounded edge nosing.
    - a. Species and Grade: Southern pine, B & Btr stepping; SPIB.
  - 2. Risers: 3/4-inch (19-mm) thick, PVC boards.

## 2.4 EXTERIOR RAILINGS

- A. Dimension Lumber Railing Members and Railing Boards: Pressure-preservative-treated grade and the following species:
  - 1. Mixed southern pine; SPIB.

## 2.5 MISCELLANEOUS MATERIALS

- A. Fasteners for Exterior Finish Carpentry: Provide nails or screws, in sufficient length to penetrate not less than 1-1/2 inches (38 mm) into wood substrate.
  - 1. Stainless-steel.
- B. Adhesive-backed Anti-Slip Tape at stair treads, as shown. Black.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Install exterior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut exterior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
- B. Install cellular PVC trim to comply with manufacturer's written instructions.
- C. Install trim with minimum number of joints as is practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary.
  - 1. Use 45-degree scarf joints for end-to-end joints.
  - 2. Stagger end joints in adjacent and related members.



- D. Fit exterior joints to exclude water. Cope at returns and miter at corners to produce tight-fitting joints, with full-surface contact throughout length of joint. Plane backs of casings to provide uniform thickness across joints, where necessary for alignment.

### 3.2 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit work to other construction; scribe and cope as needed for accurate fit.
- B. Framing Standard: Comply with American Forest & Paper Association Details for Conventional Wood-frame Construction unless otherwise indicated.

END OF SECTION 06 20 13



## SECTION 062023 - INTERIOR FINISH CARPENTRY

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Interior trim.
2. Interior stairs.

## B. Related Requirements:

1. Section 057300 "Metal Railings."
2. Section 079200 "Joint Sealants."
3. Section 096513 "Resilient Base and Accessories" for Rubber stair accessories.
4. Section 099113 "Painting."

## 1.2 ACTION SUBMITTALS

## A. Product Data: For each type of process and factory-fabricated product.

## B. Samples: For each type of material exposed to view.

## 1.3 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install materials until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

## PART 2 - PRODUCTS

## 2.1 MATERIALS, GENERAL

## A. Lumber: DOC PS 20.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. For exposed lumber, mark grade stamp on end or back of each piece.

## B. Softwood Plywood: DOC PS 1.

## C. Hardboard: ANSI A135.4.

## D. MDF: ANSI A208.2, Grade 130.

## 2.2 INTERIOR TRIM AND RAILINGS

- A. Softwood Moldings for Transparent Finish (Stain or Clear Finish): WMMPA WM 4, N-grade wood moldings. Made to patterns included in WMMPA WM 12.
  - 1. Basis-of-Design Product: Brosco Clear Pine FJP Casing 8710 to match existing.
  - 2. Maximum Moisture Content: 15 percent.

## 2.3 STAIRS

- A. Rough Carriages for Stairs: No. 2 SPF.
- B. Treads: ¾-inch plywood.
- C. Risers: 1/-inch plywood.

## 2.4 MISCELLANEOUS MATERIALS

- A. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours.

### 3.2 INSTALLATION, GENERAL

- A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Where face fastening is unavoidable, countersink fasteners, fill surface flush, and sand unless otherwise indicated.
  - 3. Install to tolerance of 1/8 inch in 96 inches (3 mm in 2438 mm) for level and plumb. Install adjoining interior finish carpentry with 1/32-inch (0.8-mm) maximum offset for flush installation and 1/16-inch (1.5-mm) maximum offset for reveal installation.
  - 4. Install stairs with no more than 3/16-inch (4.7-mm) variation between adjacent treads and risers and with no more than 3/8-inch (9.5-mm) variation between largest and smallest treads and risers within each flight.

### 3.3 STANDING AND RUNNING TRIM INSTALLATION

- A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Do not use pieces less than 24 inches (610 mm) long, except where necessary. Stagger joints in adjacent and related standing and running trim. Miter at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints.

### 3.4 STAIR AND RAILING INSTALLATION

- A. Treads and Risers at Interior Stairs: Secure treads and risers by gluing and nailing to rough carriages.
  - 1. Closed Stringers: House treads and risers into wall stringers, glue, and wedge into place.

END OF SECTION 06 20 23



## SECTION 07 21 00 - THERMAL INSULATION

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Foam-plastic board insulation.
  - 2. Mineral wool batt insulation.

## 1.2 REFERENCES

- A. ASTM C578 Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
- B. ASTM C739 Standard Specification for Cellulosic Fiber Loose-fill Insulation
- C. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- E. ASTM C1015: Standard Practice for Installation of Cellulosic and Mineral Fiber Loose-Fill Thermal Insulation.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Research/evaluation reports.

## 1.5 INSTALLER QUALIFICATIONS

- A. Spray foam installer: Approved by the foam manufacturer or certified by the Spray Polyurethane Foam Alliance (SPFA) Professional Certification Program (PCP).

## 1.6 WARRANTY

- A. Spray polyurethane foam: 3-year limited warranty.

## PART 2 - PRODUCTS

## 2.1 FOAM-PLASTIC BOARD INSULATION AT EXTERIOR AND FOUNDATION WALLS

- A. Extruded-Polystyrene Board Insulation: ASTM C 578, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84.
  - 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. Dupont
  - 2. Styrofoam Square Edge, Type IV, 25 psi.

## 2.2 MINERAL WOOL BATT INSULATION

- A. Non-combustible, lightweight, semi-rigid stone wool batt insulation to conform with ASTM C665, Type 1.
  - 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. Rockwool Inc.
  - 2. Comfortbatt. Install batts that fully fill wall cavities.

## 2.3 CELLULOSE INSULATION

- A. Loose-fill cellulose insulation conforming to ASTM C 739.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.
- C. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.



## 3.2 INSTALLATION

- A. Polyiso insulation: Stagger joints to minimize air infiltration through double-layer assembly.
- B. Cellulose insulation at attic.
  - 1. Specified R-value shall be based on the manufacturer's coverage chart. Affix thickness markers labeled in inches or R-values to trusses, with at least one marker per 300 square feet. Each marker shall face the attic access. Verify installed R-value with a bag count and certificate indicating the number of bags installed and the installed R-value.
  - 2. Minimum R-value at attic: 60.

END OF SECTION 07 21 00



## SECTION 07 27 13 - AIR BARRIERS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes:
  - 1. Sheet air barriers.
  - 2. Foam sealant.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Manufacturer's installation instructions.
- C. Warranty

## 1.3 REFERENCES

- A. ASTM E 2178: Test Method for Air Permeance of Building Materials
- B. ASTM E 331: Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Pressure Difference.
- C. ASTM D 1876: Test Method for Peel Resistance of Adhesives (T-Peel Test).
- D. ASTM E 96: Test Method for Water Vapor Transmission of Materials
- E. ASTM D 1970: Test Method for Self-adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
- F. ASTM D 6135: Standard Practice for Application of Self-adhering Modified Bituminous Waterproofing.

## 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
- B. Pre-installation meeting: Include Contractor, installer, architect, and manufacturer's representative. Review product installation, termination, penetration, and opening conditions, suitability of substrate.
- C. Project Conditions
  - 1. Do not install products in damp or wet weather or substrate conditions.

2. Do not expose air barrier to sunlight above manufacturer's limit.

## 1.5 WARRANTY

- A. Standard 10-year warranty for defects in materials.

## PART 2 - PRODUCTS

### 2.1 SHEET AIR BARRIERS

- A. Manufacturers:
  1. Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  2. SIGA.
- B. Description: Self-adhered, vapor permeable, water resistive air barrier
- C. Self-adhered membrane: Majvest 500 SA
  1. Temperature Resistance: -40 deg C to 100 deg C.
  2. Water Vapor Transmission: 13 perms.
  3. Thickness: 28 mils.
  4. Air leakage: ASTM E 2178: Pass
  5. Water Penetration Resistance: ASTM E 331: Pass (No leaks at 580 Pa on opaque and penetrated wall.)
  6. Water Vapor Transmission (ASTM E 96): 0.02 perms.
  7. Lap Adhesion: ASTM D 1876: Pass.
  8. Nail Sealability: ASTM D1976: Pass
  9. Atmospheric exposure: Six months.
- D. Flexible Flashing Tapes: Siga Wigluv. Pressure sensitive, with a modified acrylic base adhesive.
  1. Thickness: 14 mils.
  2. Water Vapor Permeance: <1.72 per ASTM E96, method A.
- E. Penetration and termination sealant: Siga Meltell 300, 1-component polymer-based sealant.

### 2.2 FOAM SEALANT

- A. Manufacturers: Dupont
- B. Description: Minimal-expanding, single component polyurethane foam sealant.
  1. Apparent Core Density, ASTM D 1622: 1.0 pounds per cubic foot.
  2. Closed cell content: ASTM D2856: 80 percent
- C. Locations:
  1. At general joints between materials: Gaps and Cracks
  2. At windows and doors: Window and Door.

### 2.3 EXECUTION

### 2.4 SURFACE PREPARATION

- A. Clean, prepare, treat, fill, and seal substrate and joints and cracks in substrate according to manufacturer's written instructions and details. Provide clean, free of oil, grease, dirt, excess mortar, frost, laitance, loose and flaking particles, and dry substrate for air-barrier application.
- B. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids in concrete with substrate-patching membrane.

### 2.5 INSTALLATION

- A. Install materials according to air-barrier manufacturer's written instructions and details and according to recommendations in ASTM D 6135 to form a seal with adjacent construction and ensure continuity of air and water barrier.
- B. Temperature: Install when air and substrate temperature is above 14 degrees Fahrenheit.
- C. Refer to air barrier manufacturer's recommendations for detailing and flashing at openings, penetrations, corners, substrate transitions, and expansion joints.
- D. Fastener penetrations: Seal with manufacturer's sealant, or use fasteners whose head is larger than the shank so that a gasketed seal can be created without compromising the air barrier.

### 2.6 CLEANING AND PROTECTION

- A. Protect air-barrier system from damage during application and remainder of construction period, according to manufacturer's written instructions.

END OF SECTION 07 27 13



## SECTION 07 31 13 - ASPHALT SHINGLES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Asphalt shingles.
  - 2. Underlayment.
  - 3. Metal flashing and trim.
  - 4. Ridge vent.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

## 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.
- B. Extra materials: Provide one bundle of shingles.

## 1.4 WARRANTY

- A. Manufacturer's Warranty: Owen's Corning System Protection Limited Warranty.
- B. Warranty requires qualified installers and the use of Owens Corning roof system components.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

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

## 2.2 GLASS-FIBER-REINFORCED ASPHALT SHINGLES

- A. Verify existing product to achieve a match with existing manufacturer, color, and texture.

- B. Laminated-Strip Asphalt Shingles: ASTM D 3462/D 3462M, laminated, multi-ply overlay construction, glass-fiber reinforced, mineral-granule surfaced, and self-sealing.
  - 1. Subject to compliance with requirements, provide Owens Corning TruDefinition Duration Shingles.
  - 2. Butt Edge: Straight cut.
  - 3. Strip Size: Manufacturer's standard.
  - 4. Algae Resistance: Granules resist algae discoloration.
  - 5. Impact Resistance: UL 2218, Class 4.
  - 6. Color and Blends: As selected by Architect to match existing.
- C. Starter shingle: Owens Corning Starter shingle roll.
- D. Ridge shingle: Owens Corning Hip & Ridge Shingles.

### 2.3 UNDERLAYMENT MATERIALS

- A. Synthetic Underlayment: Owens Corning WeatherLock Flex, flexible self-sealing ice and water barrier.
  - 1. High strength cross-laminated poly surface with modified asphalt adhesive.
  - 2. Thickness: 40 mils.

### 2.4 ACCESSORIES

- A. Roofing Nails: ASTM F 1667; aluminum, stainless-steel, copper, or hot-dip galvanized-steel wire shingle nails, minimum 0.120-inch- (3-mm-) diameter, sharp-pointed, with a minimum 3/8-inch- (9.5-mm-) diameter flat head and of sufficient length to penetrate 3/4 inch (19 mm) into solid wood decking or extend at least 1/8 inch (3 mm) through OSB or plywood sheathing.
  - 1. Shank: Barbed.
  - 2. Where nails are in contact with metal flashing, use nails made from same metal as flashing.

### 2.5 METAL FLASHING AND TRIM

- A. Sheet Metal: Zinc-tin alloy-coated steel.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

### 2.6 RIDGE VENT

- 1. Owens Corning Vent-sure 4-foot Strip Heat and Moisture Ridge Vent.



## PART 3 - EXECUTION

## 3.1 UNDERLAYMENT INSTALLATION

- A. General: Comply with underlayment manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
- B. Install on roof deck parallel with and starting at the eaves. Lap sides and ends and treat laps as recommended in writing by manufacturer. Stagger end laps between succeeding courses at interval recommended in writing by manufacturer. Cover underlayment within period recommended in writing by manufacturer.
  - 1. Install in single layer on roofs sloped at 4:12 and greater.
  - 2. Install in double layer on roofs sloped at less than 4:12.

## 3.2 METAL FLASHING INSTALLATION

- A. Install metal flashings according to manufacturer's written instructions and recommendations in ARMA's "Residential Asphalt Roofing Manual" and NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."

## 3.3 ASPHALT-SHINGLE INSTALLATION

- A. General: Install asphalt shingles according to manufacturer's written instructions, recommendations in ARMA's "Residential Asphalt Roofing Manual," and recommendations in NRCA's "NRCA Guidelines for Asphalt Shingle Roof Systems."
- B. Install starter strip along lowest roof edge, consisting of an asphalt-shingle strip at least 7 inches (175 mm) wide with self-sealing strip face up at roof edge.
  - 1. Extend asphalt shingles 1/2 inch (13 mm) over fasciae at eaves and rakes.
  - 2. Install starter strip along rake edge.
- C. Install first and remaining courses of asphalt shingles stair-stepping diagonally across roof deck with manufacturer's recommended offset pattern at succeeding courses, maintaining uniform exposure.
- D. Fasten asphalt-shingle strips with a minimum of six roofing nails located according to manufacturer's written instructions.

## 3.4 RIDGE VENT INSTALLATION

- A. Comply with manufacturer's written instructions.

END OF SECTION 07 31 13



## SECTION 07 46 33 - VINYL SIDING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes vinyl siding.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For vinyl siding including related accessories.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace products that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 50 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 VINYL SIDING

- A. Vinyl Siding: Integrally colored product complying with ASTM D 3679.
- B. Horizontal Pattern: To match existing.
- C. Texture: To match existing.
- D. Nominal Thickness: 0.044 inch.
- E. Nailing Hem: Double thickness.

- F. Finish: Clear protective coating containing not less than 70 percent PVDF.
  - 1. Colors: As selected by Architect from manufacturer's full range to match existing.

## 2.2 ACCESSORIES

- A. Provide starter strips, edge trim, outside and inside corner caps, and other items as recommended by siding manufacturer for building configuration.
  - 1. Provide aluminum accessories matching color of adjacent siding unless otherwise indicated.
- B. Provide flashing complying with Section 076200 at window and door heads and where indicated.
- C. Fasteners:
  - 1. For fastening to wood, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1 inch (25 mm) into substrate.
  - 2. For fastening to metal, use ribbed bugle-head screws of sufficient length to penetrate a minimum of 1/4 inch (6 mm), or three screw-threads, into substrate.
  - 3. For fastening vinyl, use aluminum fasteners. Where fasteners are exposed to view, use prefinished aluminum fasteners in color to match item being fastened.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. General: Comply with manufacturer's written installation instructions applicable to products and applications indicated unless more stringent requirements apply.
  - 1. Center nails in elongated nailing slots without binding siding to allow for thermal movement.
- B. Install vinyl siding and related accessories according to ASTM D 4756. Install fasteners for horizontal vinyl siding no more than 16 inches (400 mm) o.c.
- C. Install joint sealants as specified in Section 079200 and to produce a weathertight installation.

### 3.2 ADJUSTING AND CLEANING

- A. Remove damaged, improperly installed, or otherwise defective materials and replace with new materials complying with specified requirements.
- B. Clean finished surfaces according to manufacturer's written instructions and maintain in a clean condition during construction.

END OF SECTION 07 46 33

## SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Formed wall sheet metal fabrications.

## 1.2 EARLY INSTALLATION INSPECTION

- A. Provide field sample installation of one opening for Architect's approval prior to proceeding with complete installation.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.

## PART 2 - PRODUCTS

## 2.1 METAL FLASHING AND TRIM

- A. Sheet Metal: Aluminum Trim Coil. Type 3105 aluminum coil sheet.
  - 1. Exposed Coil-Coated Finish: Dymalar 2000
  - 2. Thickness: 0.024 inch.
  - 3. Color: As selected by Architect from manufacturer's full range.
- B. Fabricate sheet metal flashing and trim to comply with recommendations in the Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of the item.

## PART 3 - EXECUTION

## 3.1 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.

- B. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- C. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- D. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- E. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

### 3.2 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean off excess sealants.
- C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.

END OF SECTION 07 62 00

## SECTION 07 84 13 - PENETRATION FIRESTOPPING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Penetrations in fire-resistance-rated walls.

## 1.2 PREINSTALLATION MEETINGS

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

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.

## 1.5 CLOSEOUT SUBMITTALS

- A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

## PART 2 - PRODUCTS

## 2.1 PENETRATION FIRESTOPPING SYSTEMS

- A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

- B. Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.
  - 1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.
  - 2. T-Rating: Not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.
  - 3. W-Rating: Provide penetration firestopping systems showing no evidence of water leakage when tested according to UL 1479.
- C. Products: Basis of design Product: 3M Fire Barrier Rated Foam FIP 1-Step.
- 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 system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.
- B. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.
- C. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.
- D. Install fill materials by proven techniques to produce the following results:
  - 1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
  - 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
  - 3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

#### 3.2 IDENTIFICATION

- A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.



1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.
- B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. 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.

### 3.3 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.
- B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.
- C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

END OF SECTION 07 84 13



## SECTION 07 92 00 - JOINT SEALANTS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Silicone joint sealants.
  - 2. Latex joint sealants.
  - 3. Polyurethane foam sealants.
  - 4. Elastomeric sealants
  - 5. Butyl sealants.

## 1.2 REFERENCES

- A. ASTM C920: Standard Specification for Elastomeric Joint Sealants.
- B. ASTM C834: Standard Specification for Latex Sealants.
- C. ASTM C1330: Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
- D. ASTM C1193: Standard Guide for Use of Joint Sealants.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.

## 1.4 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.

## PART 2 - PRODUCTS

## 2.1 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. For use at exterior weather sealing.

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. GE Advanced Materials - Silicones; SilPruf LM 2700.
  - c. Pecora Corporation; 890.
  - d. Sika Corporation; Construction Products Division; SikaSil-C990.
  - e. Tremco Incorporated; Spectrem 1.

## 2.2 LATEX JOINT SEALANTS

- A. Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF. For interior and painted interior applications.
  1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
    - a. BASF Building Systems; Sonolac.
    - b. Bostik, Inc.; Chem-Calk 600.
    - c. Pecora Corporation; AC-20.
    - d. Tremco Incorporated; Tremflex 834.

## 2.3 JOINT SEALANT BACKING

- A. 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.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

## 2.4 POLYURETHANE FOAM SEALANTS

- A. Subject to compliance with requirements, provide Dow Great Stuff Pro Window & Door Insulating Foam Sealant. For window and door installations.

## 2.5 BUTYL SEALANTS

- A. As recommended by Insulated Metal Wall Panel Manufacturer.

## 2.6 ELASTOMERIC SEALANTS

- A. Sealants at masonry joints: Conforming to ASTM C 920, Grade NS, Use M.
  1. Tremco Dymonic 100
  2. Sika Sikaflex-15 LM

## 2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.
  - 1. Remove laitance and form-release agents from concrete.
  - 2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
- 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.

### 3.2 INSTALLATION

- A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- B. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 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.

- C. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.
  - 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants 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.
- F. 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.

END OF SECTION 07 92 00

## SECTION 08 10 00 – DOORS AND FRAMES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes:
  - 1. Hollow metal doors.
  - 2. Hollow metal door frames.
  - 3. Solid-core doors with wood-veneer faces.
- B. Related Requirements:
  - 1. Section 08 71 00 “Door Hardware.”

## 1.2 REFERENCES

- A. National Association of Architectural Metal Manufacturers (NAAMM)-Hollow Metal Manufacturers Association (HMMA) 803 Hollow Metal Manual Steel Tables.
- B. Steel Door Institute (SDI) A250.8 American National Standard Specifications for Standard Steel Doors and Frames.
- C. SDI A250.4 American National Standard Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors.
- D. ASTM A1008/A1008M Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.
- E. ASTM A1011/A1011M Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
- F. ASTM A653/A653M Standard Specification for Sheet Steel, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- G. ASTM A879/A879M Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- H. ASTM A153/A153M Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- I. ASTM C665 Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- J. Window and Door Manufacturers Association (WDMA) TR-6 Standards for Catalyzed Polyurethane.

- K. SDI A250.6 American National Standard Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
- L. Builders Hardware Manufacturers Association (BHMA) A156.115 Hardware Preparation in Steel Doors or Steel Frames.
- M. SDI A250.10 American National Standard Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
- N. SDI A250.11 American National Standard Recommended Erection Instructions for Steel Frames.
- O. NAAMM-HMMA 840 Hollow Metal Manual Guide Specification for Installation and Storage of Hollow Metal Doors and Frames.

### 1.3 DEFINITIONS

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

### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of exposed finish required.
- E. Warranty: For each type of product.
- F. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

## PART 2 - PRODUCTS

### 2.1 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
  - 1. Smoke- and Draft-Control Assemblies: Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.



- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

## 2.2 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  - 1. Comply with NFPA 80 requirements for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied.
- C. Openings: Factory cut and trim openings through doors.
  - 1. Light Openings: Trim openings with moldings of material and profile indicated.
  - 2. Glazing: Factory install glazing in doors indicated to be factory finished.

## 2.3 HOLLOW-METAL DOORS AND FRAMES

- A. Heavy-Duty Doors and Frames: SDI A250.8, Level 2.
  - 1. Physical Performance: Level B according to SDI A250.4.
  - 2. Doors:
    - a. Basis-of-Design Product: Subject to compliance with requirements, provide Type 707N as manufactured by Curries Manufacturing, Inc.
    - b. Type: As indicated in the Door and Frame Schedule.
    - c. Thickness: 1-3/4 inches (44.5 mm).
    - d. Face: Metallic-coated steel sheet, minimum thickness of 16 gauge steel for exterior doors and 18 gauge steel for interior doors.
    - e. Edge Construction: Model 2, Seamless.
    - f. Core: Manufacturer's standard insulation.
  - 3. Frames:
    - a. Materials:
      - 1) Exterior door and window frames: 16 gauge cold rolled A60 or G60 galvanized steel.
      - 2) Interior door and window frames: 16 gauge cold rolled steel.
    - b. Construction: Knock-down.
  - 4. Exposed Finish: Prime.

## 2.4 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2

inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

## 2.5 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.
- D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing).
- H. Glazing:
  1. At non-rated doors: Factory installed 5/8-inch insulating units, clear tempered.

## 2.6 FABRICATION

- A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  1. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  2. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  3. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
  4. Jamb Anchors: Provide number and spacing of anchors as follows:

- a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:
    - 1) Two anchors per jamb up to 60 inches (1524 mm) high.
    - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
    - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
    - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.
  - b. Stud-Wall Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c. and as follows:
    - 1) Three anchors per jamb up to 60 inches (1524 mm) high.
    - 2) Four anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
    - 3) Five anchors per jamb from 90 to 96 inches (2286 to 2438 mm) high.
    - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 96 inches (2438 mm) high.
  - c. Compression Type: Not less than two anchors in each frame.
  - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.
5. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- C. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
- D. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work. Provide lite kits compatible with rated assemblies.
  2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
  3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  4. Provide loose stops and moldings on inside of hollow-metal work.
  5. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

## 2.7 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
  - 1. Shop Primer: SDI A250.10, compatible with products specified in 099113 Painting.

## 2.8 FLUSH WOOD DOORS, GENERAL

- A. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252.
  - 1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
  - 2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

## 2.9 VENEER-FACED FLUSH WOOD DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors to match Existing
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide VT Industries or comparable product by one of the following:
    - a. Masonite Architectural.
    - b. Eggers Industries
  - 2. Species: Red Oak.
  - 3. Cut: Plain-Sliced.
  - 4. Match between Veneer Leaves: Book match.
  - 5. Assembly of Veneer Leaves on Door Faces: Center-balance.
  - 6. Pair and Set Match: Provide for doors hung in same opening.
  - 7. Exposed Vertical Edges: Veneer of same species as face, bonded to structural composite lumber, concealing edges for crossband.
  - 8. Horizontal Edges: Structural composite lumber.
  - 9. Core: Wood-based structural composite lumber.
  - 10. Construction: Five Plies. Stiles and rails are bonded to core, and then entire unit is abrasive planed before veneering.
  - 11. Warranty: Lifetime.

## 2.10 WOOD DOOR FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
  - 1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

## 2.11 WOOD DOOR FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  - 1. Finish faces and vertical edges, seal top and bottom edges as required for warranty purposes
- B. Factory finish doors.
- C. Transparent Finish:
  - 1. Grade: Premium.
  - 2. Finish: Manufacturer's standard UV cured polyurethane, equal to WDMA TR-6 catalyzed polyurethane.
  - 3. Staining: As selected by Architect to match existing doors.
  - 4. Sheen: Satin.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine doors and installed door frames, with Installer present, before hanging doors.
  - 1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs. Any deficiencies must be corrected prior to door installation.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 WOOD DOOR INSTALLATION

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
  - 1. Install fire-rated doors according to NFPA 80.
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
  - 1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold unless otherwise indicated.
  - 2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
  - 3. Trim bottom rail only to extent permitted by labeling agency.

- D. Factory-Finished Doors: Do not trim factory finished doors for width.

### 3.3 ADJUSTING

- A. Operation: Correct any deficiency that prohibits the door from swinging or operating freely. Do not remove hinge screws after initial insertion. Shims used for alignment purposes must be inserted between hinge and frame. Do not insert shims between hinge and door.
- B. To prevent stile failure, insure that door closers are properly adjusted and do not limit the door opening swing. Limit door opening swing only with a properly located stop.
- C. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

### 3.4 INSTALLATION

- A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - b. Install frames with removable stops located on secure side of opening.
    - c. Install door silencers in frames before grouting.
    - d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - f. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  - 2. In-Place Metal or Wood-Stud Partitions: Secure slip-on drywall frames in place according to manufacturer's written instructions.
  - 3. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
    - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
  - a. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
  - b. Between Edges of Pairs of Doors: 1/8 inch (3.2 mm) to 1/4 inch (6.3 mm) plus or minus 1/32 inch (0.8 mm).
  - c. At Bottom of Door: 3/4 inch (19.1 mm) plus or minus 1/32 inch (0.8 mm).
  - d. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

C. Glazing: Comply with manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) o.c. and not more than 2 inches (51 mm) o.c. from each corner.

### 3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow-metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.
- E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 10 00





## SECTION 08 52 00 - WOOD WINDOWS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes vinyl-clad wood windows.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include plans, elevations, sections, hardware, accessories, insect screens, operational clearances, and details of installation, including anchor, flashing, and sealant installation.
- C. Samples: For each exposed product and for each color specified.

## 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Sample warranties.

## 1.4 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace wood windows that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period:
    - a. Window: 10 years from date of Substantial Completion.
    - b. Glazing Units: 20 years from date of Substantial Completion.
    - c. Vinyl Cladding: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 WINDOW PERFORMANCE REQUIREMENTS

- A. Product Standard: Comply with AAMA/WDMA/CSA 101/I.S.2/A440 for definitions and minimum standards of performance, materials, components, accessories, and fabrication unless more stringent requirements are indicated.
  - 1. Window Certification: WDMA certified with label attached to each window.

- B. Performance Class and Grade: AAMA/WDMA/CSA 101/I.S.2/A440 as follows:
  - 1. Minimum Performance Class: LC.
  - 2. Minimum Performance Grade: PG 30.
- C. Thermal Transmittance: NFRC 100 maximum whole-window U-factor of 0.29 Btu/sq. ft. x h x deg.
- D. Solar Heat-Gain Coefficient (SHGC): NFRC 200 maximum whole-window SHGC of 0.32.

## 2.2 WOOD WINDOWS

- A. Vinyl-Clad Wood Windows:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Andersen 200 Series windows to match existing.
- B. Operating Types: As indicated on Drawings.
- C. Frames and Sashes: Fine-grained wood lumber complying with AAMA/WDMA/CSA 101/I.S.2/A440; kiln dried to a moisture content of not more than 12 percent at time of fabrication; free of visible finger joints, blue stain, knots, pitch pockets, and surface checks larger than 1/32 inch (0.8 mm) deep by 2 inches (51 mm) wide; water-repellent preservative treated.
  - 1. Exterior Finish: Vinyl-clad wood.
    - a. Color: White.
  - 2. Interior Finish: Unfinished.
    - a. Exposed Unfinished Wood Surfaces: Pine.
- D. Insulating-Glass Units: ASTM E 2190.
  - 1. Glass: ASTM C 1036, Type 1, Class 1, q3.
    - a. Tint: Clear.
  - 2. Lites: Two.
  - 3. Filling: Fill space between glass lites with argon.
- E. Glazing System: Manufacturer's standard factory-glazing system that produces weathertight seal.
- F. Hardware, General: Provide manufacturer's standard corrosion-resistant hardware sized to accommodate sash weight and dimensions.
  - 1. Exposed Hardware Color and Finish: As selected by Architect from manufacturer's full range.
- G. Hung Window Hardware:

1. Counterbalancing Mechanism: AAMA 902.
  2. Locks and Latches: Operated from the inside only.
  3. Tilt Hardware: Releasing tilt latch allows sash to pivot about horizontal axis.
- H. Weather Stripping: Provide full-perimeter weather stripping for each operable sash unless otherwise indicated.
- I. Fasteners: Noncorrosive and compatible with window members, trim, hardware, anchors, and other components.
1. Exposed Fasteners: Do not use exposed fasteners to greatest extent possible. For application of hardware, use fasteners that match finish hardware being fastened.

### 2.3 INSECT SCREENS

- A. General: Fabricate insect screens to integrate with window frame. Provide screen for each operable exterior sash. Screen wickets are not permitted.
1. Type and Location: Full, outside for double-hung sashes.
- B. Aluminum Frames: Complying with SMA 1004 or SMA 1201.
1. Finish for Exterior Screens: Matching color and finish of cladding.
- C. Glass-Fiber Mesh Fabric: Fiberglass screen cloth resistant to corrosion, shrinkage, stretch, impact damage, and weather deterioration. Comply with ASTM D 3656/D 3656M.
1. Mesh Color: Manufacturer's standard.

### 2.4 FABRICATION

- A. Fabricate wood windows in sizes indicated. Include a complete system for installing and anchoring windows.
- B. Glaze wood windows in the factory.
- C. Weather strip each operable sash to provide weathertight installation.
- D. Mullions: Provide mullions and cover plates, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections. Provide mullions and cover plates capable of withstanding design wind loads of window units.
- E. Complete fabrication, assembly, finishing, hardware application, and other work in the factory to greatest extent possible. Disassemble components only as necessary for shipment and installation. Allow for scribing, trimming, and fitting at Project site.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing windows, hardware, accessories, and other components. For installation procedures and requirements not addressed in manufacturer's written instructions, comply with installation requirements in ASTM E 2112.
- B. Install windows level, plumb, square, true to line, without distortion, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction to produce weathertight construction.
- C. Adjust operating sashes and hardware for a tight fit at contact points and weather stripping for smooth operation and weathertight closure.
- D. Clean exposed surfaces immediately after installing windows. Remove excess sealants, glazing materials, dirt, and other substances.
- E. Remove and replace sashes if glass has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08 52 00

## SECTION 08 71 00 - DOOR HARDWARE

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. This Section includes the following:
  - 1. Commercial door hardware for swinging doors.
- B. Related Sections include the following:
  - 1. 08 10 00 "Doors and Frames."

## 1.2 REFERENCES

- A. National Fire Protection Association (NFPA) 101 Life Safety Code.
- B. Builders Hardware Manufacturers Association (BHMA) A156.1 Butts and Hinges.
- C. BHMA A156.7 Template Hinge Dimensions.
- D. BHMA A156.2 Bored and Preassembled Locks and Latches.
- E. BHMA A156.16 Auxiliary Hardware.
- F. BHMA A156.3 Exit Devices.
- G. BHMA A156.5 Cylinders and Input Devices for Locks.
- H. BHMA A156.4 Door Controls – Closers.
- I. BHMA 156.22 Door Gasketing and Edge Seal Systems.
- J. 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.
- K. Door and Hardware Institute (DHI) A115 Installation Guide for Doors and Hardware.
- L. Steel Door Institute (SDI) ANSI A250.6 American National Standard Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.

## 1.3 SUBMITTALS

- A. General: Submittals for Sections 081000 and 087100 shall be made concurrently.

- B. Product Data: Include construction and installation details, material descriptions, dimensions of individual components and profiles, and finishes.
- C. Samples for Verification: Submit minimum 2-by-4-inch plate Samples of each type of finish required, except primed finish.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for locks, latches and closers.
- E. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware and keying schedule.
- F. Warranty: Special warranty specified in this Section.
- G. Other Action Submittals:
  - 1. Door Hardware Sets: Prepared by or under the supervision of Architectural Hardware Consultant, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final door hardware sets with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
    - a. Format: Comply with scheduling sequence and vertical format in the Door and Hardware Institute's (DHI) "Sequence and Format for the Hardware Schedule." Double space entries, and number and date each page.
    - b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
    - c. Content: Include the following information:
      - 1) Identification number, location, hand, fire rating, and material of each door and frame.
      - 2) Type, style, function, size, quantity, and finish of each door hardware item. Include description and function of each lockset and exit device.
      - 3) Complete designations of every item required for each door or opening including name and manufacturer.
      - 4) Fastenings and other pertinent information.
      - 5) Location of each door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
      - 6) Explanation of abbreviations, symbols, and codes contained in schedule.
      - 7) Mounting locations for door hardware.
      - 8) Door and frame sizes and materials.
      - 9) List of related door devices specified in other Sections for each door and frame.
    - d. Submittal Sequence: Submit initial draft of final schedule along with essential Product Data to facilitate the fabrication of other work that is critical in Project construction schedule. Submit the final door hardware sets after Samples, Product Data, coordination with Shop Drawings of other work, delivery schedules, and similar information has been completed and accepted.

2. Keying Schedule: Prepared by or under the supervision of Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- B. Architectural Hardware Consultant Qualifications: A person who is currently certified by DHI as an Architectural Hardware Consultant and who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project.
- C. Source Limitations: Obtain each type and variety of door hardware from a single manufacturer, unless otherwise indicated.
- D. Regulatory Requirements: Comply with the Americans with Disabilities Act (ADA) and with code provisions as adopted by authorities having jurisdiction.
  1. Door Hardware: Provide hardware as required by accessibility regulations and requirements of authorities having jurisdiction. These include, but are not limited to, the following:
    - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
    - b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      - 2) Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
      - 3) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
    - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
  2. NFPA 101: Comply with the following for means of egress doors:
    - a. Hardware at rated doors shall be UL Listed.
      - 1) Fire exit hardware: UL 10C.
      - 2) Panic hardware: UL 305.
    - b. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
    - c. Door Closers: Not more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
    - d. Thresholds: Not more than 1/2 inch high.

- E. Keying Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  2. Preliminary key system schematic diagram.
  3. Requirements for key control system.
  4. Address for delivery of keys.
- F. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to electrified door hardware including, but not limited to, the following:
1. Inspect and discuss electrical roughing-in and other preparatory work performed by other trades.
  2. Review sequence of operation for each type of electrified door hardware.
  3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  4. Review required testing, inspecting, and certifying procedures.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.
- B. Tag each item or package separately with identification related to the final door hardware sets, and include basic installation instructions, templates, and necessary fasteners with each item or package.
- C. Hand deliver keys to Owner.

#### 1.6 COORDINATION

- A. Templates: Distribute door hardware templates for doors, frames, and other work specified to be factory prepared for installing door hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:



- a. Structural failures including excessive deflection, cracking, or breakage.
  - b. Faulty operation of operators and door hardware.
  - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.
2. Warranty Period: One year from date of Substantial Completion, except as follows:
- a. Manual Closers: 10 years from date of Substantial Completion.

## 1.8 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

## PART 2 - PRODUCTS

### 2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets" Article.
  1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
- B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door hardware designations, as follows:
  1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements.
- C. 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.

### 2.2 HINGES, GENERAL

- A. Quantity: Provide the following, unless otherwise indicated:
  1. Two Hinges: For doors with heights up to 60 inches.
  2. Three Hinges: For doors with heights 61 to 90 inches.
  3. Four Hinges: For doors with heights 91 to 120 inches.
  4. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

- B. Template Requirements: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template-produced units.
- C. Hinge Weight: Unless otherwise indicated, provide the following:
  - 1. Entrance Doors: Heavy-weight hinges.
  - 2. Doors with Closers: Antifriction-bearing hinges.
  - 3. Interior Doors: Antifriction-bearing hinges.
- D. Hinge Base Metal: Unless otherwise indicated, provide the following:
  - 1. Exterior Hinges: Stainless steel, with stainless-steel pin.
  - 2. Interior Hinges: Stainless steel, with stainless-steel pin.
  - 3. Hinges for Fire-Rated Assemblies: Stainless steel, with stainless-steel pin.
- E. Hinge Options: Where indicated in door hardware sets or on Drawings:
  - 1. Nonremovable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for outswinging exterior doors and outswinging corridor doors with locks.
  - 2. Corners: Square.
- F. Fasteners: Comply with the following:
  - 1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
  - 2. Wood Screws: For wood doors and frames.
  - 3. Threaded-to-the-Head Wood Screws: For fire-rated wood doors.
  - 4. Screws: Phillips flat-head; machine screws (drilled and tapped holes) for metal doors and wood screws for wood doors and frames. Finish screw heads to match surface of hinges.

2.3 HINGES

- A. Butts and Hinges: BHMA A156.1.
- B. Template Hinge Dimensions: BHMA A156.7.
- C. Available Manufacturers:
  - 1. Ives, An Allegion company.
  - 2. McKinney Products Company; an ASSA ABLOY Group company.
- D. The following is a guide for hinge size and type required for this project.

	Manufacturer	Exterior	Interior
1-3/4" Wood Doors	Ives	5BB1SH HW	5BB1
	McKinney	T4A3386-4 1/2"	TB2714-4 1/2"
1-3/4" Hollow Metal	Ives	5BB1SH HW	5BB1
	McKinney	T4A3386-4 1/2"	TB2741-4 1/2"

- E. Two hinges shall be provided for each door leaf up to and including 5'-0" in height. An additional hinges shall be required for each additional 2.5 feet or fraction thereof in height.
- F. All exterior doors shall be furnished with non-removable pins.
- G. All doors over 7'-0" tall will receive a fourth hinge per leaf.

#### 2.4 LOCKS AND LATCHES, GENERAL

- A. Accessibility Requirements: Where indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
- B. Latches and Locks for Means of Egress Doors: Comply with NFPA 101. Latches shall not require more than 15 lbf to release the latch. Locks shall not require use of a key, tool, or special knowledge for operation.
- C. Lock Trim:
  - 1. Levers: Cast.
  - 2. Escutcheons (Roses): Forged.
  - 3. Dummy Trim: Match lever lock trim and escutcheons.
- D. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
  - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
  - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
  - 3. Deadbolts: Minimum 1-inch bolt throw.
- E. Rabbeted Meeting Doors: Provide special rabbeted front and strike on locksets for rabbeted meeting stiles.
- F. Backset: 2-3/4 inches, unless otherwise indicated.
- G. Strikes: Manufacturer's standard strike with strike box for each latchbolt or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, and as follows:
  - 1. Strikes for Bored Locks and Latches: BHMA A156.2.
  - 2. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

#### 2.5 LOCKS AND LATCHES

- A. BHMA A15613; Operational Grade 1; stamped steel case with steel or brass parts; Series 1000.

- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Sargent 10 Line Series LL Design
  2. Schlage ND Series RHO Rhodes Design
  3. Sargent 8200 Series LNL Occupancy Indicator Design at bathroom locks only.
- C. Locksets for labeled fire doors shall have a fusible link or other mechanism to prevent latchbolt retraction in the event of fire.
- D. Lock Functions: Lock functions as indicated in the hardware schedule shall be as follows:

FUNCTION	SARGENT	SCHLAGE	CORBIN/RUSWIN	ANSI
(1) (storeroom)	04	80	57	F86/F07
(2) (office or entry)	05	53	51	F109/F04
(3) (passage)	15	10	10	F75/F01
(4) (classroom)	37	70	55	F84/F05
(5) (classroom security)	32	71	42	F88/F09
(6) (privacy)	65	40	20	F76/F02

## 2.6 DOOR BOLTS

- A. Bolt Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
1. Mortise Flush Bolts: Minimum 3/4-inch throw.
- B. Dustproof Strikes: BHMA A156.16, Grade 1.
- C. Manual Flush Bolts: BHMA A156.16, Grade 1; designed for mortising into door edge.
1. Available Products for Hollow Metal Doors:
    - a. Ives FB458
    - b. Door Controls: 780.
    - c. Rockwood: 555.

## 2.7 EXIT DEVICES

- A. Exit Devices and Auxiliary Items: BHMA A156.3.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. SARGENT manufacturing Company; an ASSA ABLOY Group company.
      - 1) AD 8504.
    - b. Von Duprin; an Allegion company.
      - 1) Series 33NL.
  2. Panic Exit Devices: Listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

- B. Lever design shall match lock trim.

## 2.8 LOCK CYLINDERS

- A. Standard Lock Cylinders: BHMA A156.5, Grade 1.
- B. Cylinders: Manufacturer's standard tumbler type, constructed from brass or bronze, stainless steel, or nickel silver, and complying with the following:
  - 1. Number of Pins: Six.
  - 2. Bored-Lock Type: Cylinders with tailpieces to suit locks.
- C. Construction Keying: Comply with the following:
  - 1. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 5 construction master keys.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cylinders: Same manufacturer as for locks and latches.

## 2.9 KEYING

- A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A.
- B. Coordinate keying with Architect. New lock cylinders shall comply with Owner's existing system and shall be keyed appropriately.
- C. Incorporate decisions made in keying conference, and as follows:
  - 1. Master Key System: Cylinders are operated by a change key and a master key.
  - 2. Keyed Alike: Key all cylinders to same change key.
- D. Keys: Brass.
  - 1. Quantity: In addition to one extra key blank for each lock, provide the following:
    - a. Cylinder Change Keys: Three.
    - b. Master Keys: Five.

## 2.10 OPERATING AND PROTECTIVE TRIM UNITS

- A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated. Corbin Russwin Armstrong ASR, Solid stainless steel escutcheon.

## 2.11 CLOSERS

- A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Surface-Mounted Closers:
    - a. LCN Closers; an Ingersoll-Rand Company (LCN).
    - b. Sargent Manufacturing Company; Div. of ESSEX Industries, Inc. (SGT).
- C. Accessibility Requirements: Where handles, pulls, latches, locks, and other operating devices are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  - 1. Comply with the following maximum opening-force requirements:
    - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
    - b. Sliding or Folding Doors: 5 lbf applied parallel to door at latch.
    - c. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
- D. Door Closers for Means of Egress Doors: Comply with NFPA 101. Door closers shall not require more than 30 lbf to set door in motion and not more than 15 lbf to open door to minimum required width.
- E. Size of Units: Unless otherwise indicated, comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
  - 1. LCN:
    - a. Exterior: 4040 Series
    - b. Interior: 4040 Series
  - 2. Sargent:
    - a. Exterior: 281
    - b. Interior: 281

## 2.12 PUSH PLATES/PULLS

- A. Push Plates: 4-inches by 16-inches by 0.05 inches
  - 1. Ives 8200.
  - 2. Rockwood 70 Series.

- B. Pulls: 1-inch diameter by 10 inches center to center, with 3.5-inch projection and 2.5-inch clearance on 4-inch by 16-inch plate.
  - 1. Ives 8303 8300 Plate with 8103 Pull.
  - 2. Rockwood BF111 x 70C.

## 2.13 KICKPLATES

- A. Rockwood K1050, .050" stainless steel, or approved equal.
  - 1. Size: 8-inches high x door width minus 2 inches.

## 2.14 STOPS AND HOLDERS

- A. Stops and Bumpers: BHMA A156.16, Grade 1.
  - 1. Provide wall stops for doors unless floor or other type stops are indicated. Do not mount floor stops where they will impede traffic. Where floor or wall stops are not appropriate, provide overhead holders.
  - 2. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible, and except as otherwise indicated. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening. In general, match items to the manufacturer's standard finish for the latch and lock set (or push-pull units if no latch-lock sets) for color and texture.
- B. Wall Stops: Wall type bumpers with concealed type flange shall be used where ever possible.
  - 1. Available Products:
    - a. Ives - 407 1/2
    - b. Glynn Johnson – WB60M
    - c. Rockwood - 409
- C. Wall Stop with Manual Wall Holder.
  - 1. Available Products: Ives WS445, WS449.
- D. Floor Stops: Where wall type bumpers cannot be used, provide dome type, floor mounted stops of the proper height as follows:
  - 1. Available Products:
    - a. Ives – 441 x Machine Screws
    - b. Glynn Johnson – FB10E x Machine Screws
    - c. Rockwood – 442 Machine Screws
- E. Silencers for Metal Door Frames: BHMA A156.16, Grade 1; neoprene or rubber, minimum diameter 1/2 inch; fabricated for drilled-in application to frame.

## 2.15 DOOR GASKETING

- A. Standard: BHMA A156.22.

- B. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.
- C. Weatherstripping:
  - 1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Basis-of-Design Product, No. A626A by National Guard Products or approved substitute.
  - 2. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed. Basis-of-Design Product, No. 600A by National Guard Products or approved substitute.
  - 3. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed. Basis-of-Design Product, No. 95WH by National Guard Products or approved substitute.
- D. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

## 2.16 THRESHOLDS

- A. Standard: BHMA A156.21.
- B. Accessibility Requirements: Where thresholds are indicated to comply with accessibility requirements, comply with the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)."
  - 1. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
- C. Thresholds for Means of Egress Doors: Comply with NFPA 101. Maximum 1/2 inch high.  
  
Exterior Thresholds: Provide No. 896 with door bottom sweep No. 95WH by National Guard Products or approved substitute.
- D. Thresholds at automatic door bottoms: Pemko 271 Saddle Threshold

## 2.17 AUTOMATIC DOOR BOTTOMS

- A. Pemko 4301\_RL.
  - 1. Semi mortise model.
  - 2. Material: Extruded tempered aluminum 6063-T6
  - 3. Clear anodized finish.
  - 4. Seal: Soft closed cell sponge neoprene
  - 5. Provide end plates.



## 2.18 FABRICATION

- A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.
  - 1. Manufacturer's identification is permitted on rim of lock cylinders only.
- B. Base Metals: Produce door hardware units of base metal, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18. Do not furnish manufacturer's standard materials or forming methods if different from specified standard.
- C. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.
  - 1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
  - 2. Steel Machine or Wood Screws: For the following fire-rated applications:
    - a. Mortise hinges to doors.
    - b. Strike plates to frames.
    - c. Closers to doors and frames.
  - 3. Steel Through Bolts: For the following fire-rated applications unless door blocking is provided:
    - a. Surface hinges to doors.
    - b. Closers to doors and frames.
    - c. Surface-mounted exit devices.
  - 4. Spacers or Sex Bolts: For through bolting of hollow-metal doors.

## 2.19 FINISHES

- A. Standard: BHMA A156.18, as indicated in door hardware sets.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are

acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Provide the following finishes:

- |    |                          |                      |
|----|--------------------------|----------------------|
| 1. | Butts and Hinges:        | 26D/32D              |
| 2. | Continuous Gear Hinges   | 28                   |
| 3. | Locks & Lock Trim:       | 26D                  |
| 4. | Door Controls - Closers: | Sprayed Alum. Finish |
| 5. | Door Stops               | 26D/32D              |
| 6. | Weatherstripping         | Aluminum             |
| 7. | Threshold                | Aluminum             |
| 8. | Kickplates               | 32D                  |
| 9. | Pulls                    | 32D                  |

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Steel Doors and Frames: Comply with DHI A115 Series.
  - 1. Surface-Applied Door Hardware: Drill and tap doors and frames according to ANSI A250.6.

#### 3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights indicated as follows unless otherwise indicated or required to comply with governing regulations.
  - 1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 09 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
  2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- C. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

### 3.4 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
1. Door Closers: Unless otherwise required by authorities having jurisdiction, adjust sweep period so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.
- B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer shall examine and readjust, including adjusting operating forces, each item of door hardware as necessary to ensure function of doors, door hardware, and electrified door hardware.

### 3.5 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

### 3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain door hardware and door hardware finishes. Refer to Division 01 Section "Demonstration and Training."

### 3.7 DOOR HARDWARE SETS

- A. The hardware sets listed below indicate the items of hardware required for each opening. It is the bidder's responsibility to accurately furnish the proper quantities, items, sizes, weights and functions as required by the plans and specifications. If an opening has, through error, been omitted from the following hardware sets, it shall be the bidder's responsibility to supply hardware of equivalent quality and quantity, as that which is specified for a comparable opening.

GROUP 1

Hinges  
Lockset (Function Office)  
Wall Stop

GROUP 2

Hinges  
Lockset (Function Entrance)  
Wall Stop

GROUP 3

Hinges  
Lockset (Function Storeroom)  
Closer on active leaf  
Manual Flush Bolts  
Astragal

GROUP 4

Hinges  
Rim Exit (Function Entrance)  
Closer  
Weatherstripping  
Threshold

GROUP 5

Hinges  
Rim Exit (Function Passage)  
Closer  
Gasketing

GROUP 6

Hinges  
Lockset (Function Storeroom)  
Closer

GROUP 7

Hinges  
Latchset (Function Passage)  
Wall Stop

GROUP 8

Hinges  
Latchset (Function Passage)  
Wall Stop  
Gasketing  
Threshold  
Automatic door bottom.

END OF SECTION 08 71 00



## SECTION 09 22 16 - NON-STRUCTURAL METAL FRAMING

## PART 1 - GENERAL

## 1.1 SUMMARY

## A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.

## 1.2 RELATED SECTIONS

- A. 09 29 00 "Gypsum Board."

## 1.3 REFERENCES

- A. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM C754 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products.
- C. ASTM C645 Standard Specification for Nonstructural Steel Framing Members.
- D. ASTM A653/A653M Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- E. ASTM A1003 Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.
- F. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board.

## 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.

## 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Steel Framing and Furring:
    - a. Clark Dietrich Building Systems, ProSTUD™ Drywall Framing System.
    - b. MarinoWare; Division of Ware Ind.
    - c. Super Stud Building Products, Inc.
    - d. The Steel Network, Inc.

## 2.2 FRAMING SYSTEMS

- A. Light Gage Framing Members, General: Comply with ASTM C 754 for conditions indicated.
1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.
  2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized or equivalent per ASTM A1003.
- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
1. Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: Not less than 0.027 inch or as indicated by UL assembly. Limit deflection to  $L/360$  at a lateral load of 7.5 psf.
    - b. Depth: As indicated on Drawings.
  2. Dimpled Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: As indicated on Drawings or not less than 0.025 inch.
    - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where partitions extend from floor to structure above, provide one of the following:
1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.



3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- a. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

- 1) Clark Dietrich BlazeFrame DL.

- D. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: As indicated on Drawings 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

- E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.0179 inch.
2. Depth: As indicated on Drawings.

### 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

- B. Install bracing at terminations in assemblies.

- C. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.3 INSTALLING FRAMED ASSEMBLIES

- A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- B. Install studs so flanges within framing system point in same direction.
  - 1. Space studs as follows:
    - a. Single-Layer Construction: 16 inches o.c., unless otherwise indicated.
- C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two 0.312 inch (0.79 mm) (20 gage) studs at each jamb, unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
  - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
    - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
  - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- D. Direct Furring:
  - 1. Screw to substrate.
  - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

END OF SECTION 09 22 16

## SECTION 09 29 00 - GYPSUM BOARD

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

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

## 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Interior gypsum board.
- B. Related Sections include the following:
  - 1. Division 06 Section "Rough Carpentry."
  - 2. Division 07 Section "Thermal Insulation."
  - 3. Division 07 Section "Joint Sealants."
  - 4. Division 09 Section "Non-Structural Metal Framing."

## 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site. Coordinate gypsum finishing and paint sheen.

## 1.4 REFERENCES

- A. ASTM E119 Standard Test Methods for Fire Tests of Building Construction and Materials.
- B. ASTM C840 Standard Specification for Application and Finishing of Gypsum Board
- C. ASTM C1396/C1396M Standard Specification for Gypsum Board.
- D. ASTM C1177/C1177M Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- E. ASTM C1178/C1178M Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel.
- F. ASTM D3273 Standard Test Method for Resistance to growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- G. ASTM C1047 Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

- H. ASTM C475/C475M Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- I. ASTM C1002 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- J. ASTM C954 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch (0.84 mm) to 0.112 inch (2.84 mm) in Thickness.
- K. ASTM E 497 Standard Practice for Installing Sound Isolating Lightweight Partitions.

#### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size sample in 12-inch- long length for each trim accessory indicated.

#### 1.6 STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install interior products until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or blotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

## 2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

## 2.2 INTERIOR GYPSUM BOARD

- A. General: Complying with ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

- 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

- a. American Gypsum Co.
- b. Certainteed Gypsum.
- c. G-P Gypsum.
- d. Lafarge North America Inc.
- e. National Gypsum Company.
- f. Temple.
- g. USG Corporation.

- B. Type X:

- 1. Thickness: 5/8 inch.
- 2. Long Edges: Tapered.

## 2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.

- 1. Material:

- a. Galvanized or aluminum-coated steel sheet or rolled zinc.
- b. Trim-Tex, Super Seal Tear Away™ L Bead where abutting exterior metal doors and windows.

- 2. Shapes:

- a. Cornerbead.
- b. LC-Bead: J-shaped; exposed long flange receives joint compound.
- c. Expansion (control) joint.

## 2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.

- B. Joint Tape:
  - 1. Interior Gypsum Wallboard: Paper.
  - 2. Tile Backing Panels: As recommended by panel manufacturer.
  
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  - 1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
    - a. Use setting-type taping with mold-resistant gypsum wallboard.
  - 3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
  - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  - 5. Skim Coat: At toilets for use with semi-gloss paint finish.

## 2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
  
- B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames and framing, for compliance with requirements and other conditions affecting performance.
  
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
  
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.

- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members, or provide control joints to counteract wood shrinkage.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Type X: All surfaces, unless otherwise indicated.
- B. Single-Layer Application:
  - 1. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
  3. Air-tight installation: Seal sound pathways, including at floor, ceiling, corners and penetrations.
- C. Double-Layer Application:
1. Provide two layers of gypsum panels where shown.
  2. Provide a layer of viscoelastic sealant between layers of gypsum panels.
  3. Stagger joints between interior and exterior layers.
  4. Air-tight installation: Seal sound pathways, including at floor, ceiling, corners and penetrations.

### 3.4 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings or according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
1. Cornerbead: Use at outside corners, unless otherwise indicated.
  2. LC-Bead: Use at exposed panel edges.

### 3.5 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 2: Where indicated on Drawings.
  3. Level 3: Where indicated on Drawings.
  4. Level 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

### 3.6 FIELD QUALITY CONTROL



- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.
  - 1. Complete the following in areas to receive gypsum board ceilings:
    - a. Installation, insulation, and leak and pressure testing of water piping systems.
    - b. Installation of air-duct systems.
    - c. Installation of air devices.
    - d. Installation of mechanical system control-air tubing.
    - e. Installation of ceiling support framing.
    - f. Installation of Penetration Firestopping.

### 3.7 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 29 00



## SECTION 09 51 23 - ACOUSTICAL TILE CEILINGS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes acoustical tiles, and concealed suspension systems for ceilings.

## 1.2 REFERENCES

- A. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM E1264 Standard Classification for Acoustical Ceiling Products.
- C. ASTM C635 Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.
- E. ASTM C636/C636M Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels.

## 1.3 PREINSTALLATION MEETINGS

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

## 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Warranty: For each type of product.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Evaluation reports.
- C. Field quality-control reports.

## 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.7 EXTRA MATERIALS

- A. Provide extra materials in the manufacturer's unopened packaging, with the manufacturer's label intact, as detailed below.
  - 1. Acoustic Tiles: Minimum 5% of each type installed.
  - 2. Suspension System Components: Minimum 5% of each type installed.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  - 2. Smoke-Developed Index: 50 or less.

## 2.2 ACOUSTICAL TILE CEILINGS, GENERAL

- A. Acoustical Tile Standard: Comply with ASTM E 1264.
- B. Metal Suspension System Standard: Comply with ASTM C 635.
- C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- D. Warranty: Manufacturer's 10-year warranty.

## 2.3 CEILING SC1

- A. Acoustical Tiles
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed Performa Symphony f 1342B-IOF-1 or comparable product.
  - 2. Color: White.
  - 3. NRC: .95.
  - 4. LR: .90.
  - 5. Edge Profile Detail: Reveal.
  - 6. Thickness: 1-inch.
  - 7. Modular Size: 24-inch by 24-inch.
  - 8. Surface Washability per ASTM D 4828 tested to 100 cycles with chemical sanitizers in manufacturer's recommended dilution.
  - 9. Type: ASTM E1264 Type XII, fiberglass core with laminated finished surface.

- B. Metal Suspension System
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide CertainTeed 15/16" Classic Stab System or comparable product.
  - 2. Structural Classification: Intermediate-duty system.
  - 3. Access: Upward.
  - 4. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Manufacturer's standard moldings for edges and penetrations complying with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.
  - 5. Color: White.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install acoustical tile ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.
- C. Arrange directionally patterned acoustical tiles as indicated on reflected ceiling plans.

END OF SECTION 09 51 23



## SECTION 09 65 13 - RESILIENT TILE, BASE, AND ACCESSORIES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Rubber floor tile.
  - 2. Resilient base and accessories.
  - 3. Rubber stair accessories.

## 1.2 REFERENCES

- A. ASTM E648 Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- B. National Fire Protection Association (NFPA) 253 Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- C. ASTM F1861 Standard Specification for Resilient Wall Base.
- D. 40 Code of Federal Regulations (CFR) 59, Subpart D National Volatile Organic Compound Emission Standards for Architectural and Commercial Products.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For each type of product indicated, of each resilient product color required.
- C. Warranty: For each type of product.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

## 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
- C. Install resilient products after other finishing operations, including painting, have been completed.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

## PART 2 - PRODUCTS

## 2.1 RUBBER FLOOR TILE I-TF-1

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Basis-of-Design Product: Tarkett Johnsonite Rubber Tile.
- C. Tile Standard: ASTM F 1344, Class I-A, homogeneous rubber tile, solid color.
- D. Hardness: Not less than 85 as required by ASTM F 1344, measured using Shore, Type A durometer per ASTM D 2240.
- E. Wearing Surface: As selected by Architect from manufacturer's full range.
- F. Thickness: 0.125 inch.
- G. Size: 24 by 24 inches.
- H. Warranty: Five years from date of Substantial Completion.
- I. Colors and Patterns: As selected by Architect from full range of industry colors.

## 2.2 RESILIENT BASE RB-1

- A. Resilient Base:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong World Industries, Inc.
  - b. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
  - c. Endura Rubber Flooring; Division of Burke Industries, Inc.
  - d. Flexco, Inc.
  - e. Johnsonite.
  - f. Musson, R. C. Rubber Co.
  - g. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
  - h. Roppe Corporation, USA.

B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TP (rubber, thermoplastic).
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).
4. Warranty: 2 years.

C. Minimum Thickness: 0.125 inch (3.2 mm).

D. Height: 4 inches (102 mm).

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As selected by Architect from full range of industry colors.

## 2.3 RUBBER STAIR ACCESSORIES

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Basis-of-Design Product: Tarkett Angle Fit Rubber Stair Tread with Integrated Riser.

1. Tarkett Raised Round Tread/Riser.

C. Stair Treads: ASTM F 2169.

1. Type TS, Class 2 embossed, Group 2, contrasting for visually impaired.
2. Colors and Patterns: As selected by Architect from full range of industry colors.

D. Test data:

1. Hardness (ASTM D2240):  $\geq 85$  Shore A
2. Resistance to Chemicals (ASTM F925): Passes
3. Resistance to Heat (ASTM F 1514):  $\Delta E \leq 8$
4. Static Coefficient of Friction (ASTM D 2047):  $\geq 0.5$  SCOF
5. Flamability (ASTM E648, Critical Radiant Flux): Class 1 ( $\geq 0.45$  W/cm<sup>2</sup>)

6. Limited Commercial Warranty: 5 years
- E. Nosing Style: Square, adjustable to cover angles between 60 and 90 degrees.
  1. Nosing Height: 2 inches.
  2. Thickness: 0.070 inch to 0.091 inch.
  3. Size: Lengths and depths to fit each stair tread in one piece.
  4. Integral Risers: Smooth, flat; in height that fully covers substrate.
- F. Stringers: Height and length after cutting to fit risers and treads and to cover stair stringers; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.
  1. Thickness: Manufacturer's standard.
- G. Landings:
  1. Tile matching treads; produced by same manufacturer as treads and recommended by manufacturer for installation with treads.

#### 2.4 VINYL MOLDING ACCESSORY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Armstrong World Industries, Inc.
  2. Burke Mercer Flooring Products; Division of Burke Industries, Inc.
  3. Endura Rubber Flooring; Division of Burke Industries, Inc.
  4. Flexco, Inc.
  5. Johnsonite.
  6. Musson, R. C. Rubber Co.
  7. Nora Rubber Flooring; Freudenberg Building Systems, Inc.
  8. Roppe Corporation, USA.
- B. Description: Vinyl nosing for carpet, nosing for resilient flooring, reducer strip for resilient flooring, joiner strips, transition strips. Corner guards.
- C. Locations: As required to create smooth transition between flooring materials.
- D. Colors and Patterns: As selected by Architect from full range of industry colors.

#### 2.5 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
  1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

## 3.1 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

## 3.2 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  - 1. Lay tiles in pattern of colors and sizes indicated.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.
- G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

- H. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Job-Formed Corners:
  - 1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends.
  - 2. Inside Corners: use straight pieces of maximum lengths possible.

### 3.4 STAIR TREAD INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient stair treads.
- B. Install with manufacturer's recommended adhesive specified for the site conditions and follow adhesive label for proper use.
- C. Stair Treads with Integral Riser use a cove filler strip where the tread meets the riser.

### 3.5 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

### 3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

- B. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
  
- C. Cover resilient products until Substantial Completion.

END OF SECTION 09 65 13



## SECTION 09 65 16 - RESILIENT SHEET FLOORING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes vinyl sheet flooring.

## 1.2 REFERENCES

- A. ASTM F1913 Standard Specification for Vinyl Sheet Floor Covering Without Backing.
- B. ASTM D2047 Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine.
- C. ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
- D. ASTM F1869 Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.
- E. ASTM F2170 Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
- F. ASTM F1516 Standard Practice for Sealing Seams of Resilient Flooring Products by the Heat Weld Method (when Recommended).
- G. ASTM F970 Standard Test Method for Measuring Recovery Properties of Floor Coverings after Static Loading.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
- C. Samples: For each exposed product and for each color and texture specified in manufacturer's standard size, but not less than 6-by-9-inch (150-by-230-mm) sections.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches (230 mm) long, of each color required.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.5 WARRANTY

- A. Manufacturer's ten year warranty.

## PART 2 - PRODUCTS

### 2.1 VINYL SHEET FLOORING I-RF-1 WITH INTEGRAL COVE BASE

- A. Basis-of-Design Product: Altro Cantata adhesive-free flooring.
  - 1. Slip Resistance: .7/D .9/W.
  - 2. Static Load Limit: ASTM F970: 2000psi.
  - 3. Thickness: 2.2 mm (.087 inch).
  - 4. Sheet Width: As standard with manufacturer.
  - 5. Seamless-Installation Method: Heat welded.
  - 6. Colors and Patterns: Frosted Glass AFP282005.

### 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
- B. Seamless-Installation Accessories:
  - 1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
    - a. Color: Match flooring.
- C. Integral-Flash-Cove-Base Accessories:
  - 1. Cove Strip: Radius provided or approved by resilient sheet flooring manufacturer.
  - 2. Cap Strip: Manufacturer's vinyl cap strip.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions.
- B. Concrete Substrates: Prepare according to ASTM F 710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.



3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing.
4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:
  - a. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

### 3.2 RESILIENT SHEET FLOORING INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient sheet flooring.
- B. Seamless Installation:
  1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.
- C. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches (152 mm) up vertical surfaces. Overlap vinyl wall covering 2 inches on top of flooring. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip as recommended in writing by manufacturer.

### 3.3 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.
- B. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 09 65 16



## SECTION 09 68 16 - SHEET CARPETING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Tufted carpet.

## 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For each exposed product and for each color and texture required.

## 1.3 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## 1.4 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 TUFTED CARPET I-CF-1

- A. Basis-of-Design Product to match Owner's existing: Main Street 26 oz. Broadloom Carpet.
- B. Color: Talisman.
- C. Tufted Weight: 26 oz./sq. yd.

## 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet manufacturer.

- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Concrete Slabs:
  - 1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft., and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    - a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
    - c. Perform additional moisture tests recommended in writing by adhesive and carpet manufacturers. Proceed with installation only after substrates pass testing.
- B. Wood Subfloors: Verify that underlayment surface is free of irregularities and substances that may interfere with adhesive bond or show through surface.

#### 3.2 PREPARATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard" and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

#### 3.3 CARPET INSTALLATION

- A. Comply with CRI's "CRI Carpet Installation Standard" and carpet manufacturer's written installation instructions for the following:

1. Direct-glue-down installation.
  - B. Comply with carpet manufacturer's written instructions and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
  - C. Do not bridge building expansion joints with carpet.
  - D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
  - E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
  - F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet as marked on subfloor. Use nonpermanent, nonstaining marking device.
  - G. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 09 68 16



## SECTION 09 91 13 - PAINTING

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes surface preparation and the application of paint systems on interior substrates.
  - 1. Wood.
  - 2. Gypsum board.
  - 3. Metal
    - a. Pipe and Tube Railings
    - b. Hollow metal doors and frames.

## 1.2 PREINSTALLATION MEETINGS

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

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples: For each type of paint system and in each color and gloss of topcoat.
- C. Product List: For each product indicated. Include printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.

## 1.4 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to products listed in other Part 2 articles for the paint category indicated.

## 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. Colors: As selected by Architect from manufacturer's full range Match Architect's samples As indicated in a color schedule Insert requirements.

## 2.3 PRIMERS/SEALERS

- A. Primer, Latex, for Gypsum Board: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Primer B28W02600, 4.0 mils wet, 1.0 mils dry, per coat.
- B. Primer, Acrylic, for Metal: Sherwin-Williams ProIndustrial Pro-Cryl Universal Primer B66 series, 5.0-10.0 mils wet, 1.8-3.6 mils dry, per coat.

## 2.4 WATER-BASED PAINTS

- A. Latex Egg Shell: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Low Gloss Eg-Shel B41W02651, 4.0 mils wet, 1.6 mils dry, per coat.
- B. Latex Semi-Gloss: Sherwin-Williams ProMar 200 Zero VOC Interior Latex Semi-Gloss B31W02651, 4.0 mils wet, 1.5 mils dry, per coat.
- C. Acrylic Urethane: Sherwin-Williams Pro Industrial Acrolon 100 Waterbased Urethane Gloss B65-700 Series, 4.0-8.0 mils wet, 1.8-3.6 mils dry, per coat.
- D. Acrylic: Sherwin-Williams Pro Industrial Acrylic Semi-Gloss B66W00651, 6.0 mils wet, 2.4 mils dry, per coat.
- E. Urethane: Minwax Water Based Helmsman Spar Urethane Satin 710520000, dry film thickness 2.0 mil. Tint to match existing stain.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.



- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Wood: 15 percent.
  - 2. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
- B. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 CLEANING AND PROTECTION

- A. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- B. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.5 PAINTING SCHEDULE

#### A. Wood Substrates:

1. Urethane system:
  - a. First Coat: Urethane, to match second coat.
  - b. Second Coat: Urethane Satin to match tint of existing.

#### B. Gypsum Board Substrates:

1. Egg Shell System (at walls unless otherwise noted):
  - a. Prime Coat: Latex.
  - b. First Coat: Latex, to match second coat.
  - c. Second Coat: Latex Egg Shell.
2. Semi-Gloss System:
  - a. Prime Coat: Latex.
  - b. First Coat: Latex, to match second coat.
  - c. Second Coat: Latex Semi-Gloss.
3. Flat System (at ceilings unless otherwise noted):
  - a. Prime Coat: Latex.
  - b. First Coat: Latex, to match second coat.
  - c. Second Coat: Latex Flat.

#### C. Metal Substrates:

1. Gloss System (at metal unless otherwise noted):
  - a. Prime Coat: Acrylic.
  - b. First Coat: Acrylic Urethane, to match second coat.
  - c. Second Coat: Acrylic Urethane, Gloss.
2. Semi-Gloss System (at hollow metal doors and frames unless otherwise noted):
  - a. Prime Coat: Acrylic.
  - b. First Coat: Acrylic, to match second coat.
  - c. Second Coat: Acrylic, Semi-Gloss.

### 3.6 PAINT COLOR SCHEDULE

- A. IP-1: At walls unless otherwise indicated. As selected by Architect.
- B. IP-2: Sherwin-Williams 7007 Ceiling Bright White. At ceilings unless otherwise indicated.
- C. IP-3: Owner's Accent Color. As selected by Architect.
- D. IP-4: Owner's Accent Color. As selected by Architect.
- E. IP-5: Owner's Accent Color. As selected by Architect.

END OF SECTION 09 91 13

## SECTION 10 14 00 - SIGNAGE

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Room-identification signs.

## 1.2 REFERENCES

- A. ASTM D4802 Standard Specification for Poly (Methyl Methacrylate) Acrylic Plastic Sheet.

## 1.3 ACTION SUBMITTALS

- A. Shop Drawings: For panel signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
- B. Samples: For each exposed product and for each color and texture specified.
- C. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

## 1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

## 2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for signs.

## 2.2 MATERIALS

- A. Acrylic Sheet: ASTM D 4802, Category A-1 (cell-cast sheet), Type UVA (UV absorbing).
- B. ABS Plastic: Provide high-impact thermoplastic composed of copolymers of acrylonitrile, butadiene, and styrene.

## 2.3 PANEL SIGNS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
  - 1. Neokraft, Lewiston, Maine.
  - 2. Mohawk Sign Systems.
  - 3. Welch Architectural Signage.
- B. Substrate: Fabricate signs from 1/8 inch thick matte clear acrylic with edges mechanically and smoothly finished to eliminate cut marks. Background color to be subsurface.
  - 1. Background Color: As selected by the Architect from manufacturer's standard colors.
  - 2. Edge Condition: Straight.
  - 3. Corner Condition: Rounded to 3/8 inch radius.
  - 4. Size: As shown on Drawings.
- C. Copy: Helvetica.
- D. Letterform: route copy into face of substrate 1/32 inch deep. Chemically weld (inlay) computer precision cut tactile copy into routed letter openings so that tactile copy is embedded in substrate and remains at least 1/32" above surface of substrate.
  - 1. Height: 5/8 inch minimum letter height.
- E. Braille: Use engrave process for all Braille areas. Engrave Braille dots into surface of clear material.
- F. Symbols of Accessibility:
  - 1. Accessible elements: Provide international symbol of accessibility.
    - a. Provide male and female symbols as required for toilets.
- G. Provide characters complying with ADA Accessibility Guidelines and ICC/ANSI A117.1. Text shall be accompanied by Grade 2 braille.

## 2.4 FINISHES

- A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. General: Locate signs where indicated. Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Mounting Methods:
1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.
  3. Standoffs: Per manufacturer's instructions for mounting on substrate indicated.
- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 10 14 00



## SECTION 12 24 13 - ROLLER WINDOW SHADES

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes manually operated roller shades.

## 1.2 REFERENCES

- A. WCMA A100.1: American National Standard for Safety of Corded Window Covering Products.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.
- B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.
- C. Samples: For each exposed product and for each color and texture specified.

## 1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

## PART 2 - PRODUCTS

## 2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Draper Manual clutch-Operated FlexShades or comparable product by one of the following:
  - 1. Hunter Douglas Contract.
  - 2. MechoShade Systems, Inc.

## 2.2 ROLLER SHADES

- A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's stainless steel.
  - a. Loop Length: Full length of roller shade.
  - b. Limit Stops: Provide upper and lower ball stops.
  - c. Chain-Retainer Type: Chain tensioner, jamb mounted.
  
- B. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.
  1. Roller Mounting Configuration: Single roller.
  2. Roller Drive-End Location: Right side of inside face of shade.
  3. Direction of Shadeband Roll: Regular, from back of roller.
  4. Shadeband-to-Roller Attachment: Manufacturer's standard method.
  
- C. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.
  
- D. Shadebands:
  1. Shadeband Material: Draper HunterDouglas Contract GreenScreen X-Lite 0% Openness 100% Polyester, Color to be selected by Architect from manufacturer's full range.
  2. Shadeband Bottom (Hem) Bar: Extruded aluminum.
    - a. Type: Enclosed in sealed pocket of shadeband material.
  
- E. Installation Accessories:
  1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
    - a. Shape: L-shaped.
    - b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 3 inches (76 mm).
    - c. Color: To match shadeband color.
    - d. Finish: Matte.

### 2.3 ROLLER-SHADE FABRICATION

- A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.
  
- B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F (23 deg C):
  1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch (6 mm) per side or 1/2-inch (13-mm) total, plus



- or minus 1/8 inch (3.1 mm). Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch (6 mm), plus or minus 1/8 inch (3.1 mm).
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.
- C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible.

### PART 3 - EXECUTION

#### 3.1 ROLLER-SHADE INSTALLATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Install roller shades level, plumb, and aligned with adjacent units, according to manufacturer's written instructions.
  1. Opaque Shadebands: Located so shadeband is not closer than 2 inches (50 mm) to interior face of glass. Allow clearances for window operation hardware.
- D. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- E. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.
- F. Provide at all new exterior windows.

END OF SECTION 12 24 13



## SECTION 12 32 00 – MANUFACTURED WOOD CASEWORK

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section includes casework and cabinets.
- B. Related Requirements:
  - 1. Section 12 36 61 "Solid Surface Countertops."

## 1.2 DEFINITIONS

- A. MDF: Medium-density fiberboard.

## 1.3 ACTION SUBMITTALS

- A. Product Data: For the following:
  - 1. Cabinets.
  - 2. Cabinet hardware.
- B. Shop Drawings: Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, and hardware.
- C. Samples: For cabinet finishes.
- D. Warranty: For each product.

## 1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For casework.

## PART 2 - PRODUCTS

## 2.1 CABINETS

- A. Basis of Design Product: Subject to compliance with requirements, provide Advanta AllWood Series cabinets.
- B. Quality Standard: Provide cabinets that comply with KCMA A161.1.
- C. Face Style: Full overlay.

- D. Cabinet Style: Frameless.
- E. Door and Drawer Fronts:
  - 1. Avenue slab doors, 5/8-inch-thick, melamine doors and drawer fronts, thermally fused to CARB2-compliant composite panel core; edge banded on all four sides.
- F. Cabinet Materials
  - 1. General:
    - a. Hardwood Lumber: Kiln dried to 7 percent moisture content.
    - b. Softwood Lumber: Kiln dried to 10 percent moisture content.
    - c. Hardwood Plywood: HPVA HP-1.
    - d. Particleboard: ANSI A208.1, Grade M-2.
    - e. MDF: ANSI A208.2, Grade MD.
    - f. Hardboard: ANSI A125.4, Class 1 Tempered.
- G. Exposed Materials:
  - 1. Exposed Material: Laminate.
    - a. Finish: Classic White.
  - 2. End Panels: Finish to match doors.
- H. Semiexposed Materials: Unless otherwise indicated, provide the following:
  - 1. Plywood: Hardwood plywood with Grade C faces and not less than Grade 3 backs of same species as faces. Face veneers of same species as exposed surfaces or stained to be compatible with exposed surfaces.
- I. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility; particleboard; MDF; or hardboard.
- J. Warranty: One year.

## 2.2 CABINET HARDWARE

- A. General: Manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.
- B. Pulls: Manufacturer's Naples solid bar pulls.
  - 1. Doors: 8-1/8-inch length.
  - 2. Drawers: 6-1/8-inch length.
- C. Hinges: Concealed European-style, self-closing hinges.
- D. Drawer Guides: Epoxy-coated-metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHMA A156.9, Type B05011 or Type B05091.

## PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.
- B. Install cabinets without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.
- C. Install cabinets level and plumb to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m).
- D. Fasten cabinets to adjacent units and to backing.
  - 1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches (400 mm) o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch (38-mm) penetration into wood framing, blocking, or hanging strips.

## 3.2 ADJUSTING AND CLEANING

- A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 12 35 30



## SECTION 12 36 61 – SOLID SURFACE COUNTERTOPS

## PART 1 - GENERAL

## 1.1 SUMMARY

- A. Section Includes:
  - 1. Solid-surface-material countertops and backsplashes.
- B. Related Requirements:
  - 1. Section 12 32 00 "Manufactured Wood Casework."

## 1.2 ACTION SUBMITTALS

- A. Product Data: For countertop materials.
- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
- C. Samples: For each type of material exposed to view.
- D. Warranty: For each type of product.

## PART 2 - PRODUCTS

## 2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

- A. Configuration: Provide countertops with the following front and backsplash style:
  - 1. Front: Straight, slightly eased at top.
  - 2. Backsplash: Straight, slightly eased at corner.
  - 3. Endsplash: Matching backsplash.
- B. Countertops: 1/2-inch-thick, solid surface material with front edge built up with same material.
- C. Backsplashes: 1/2-inch-thick, solid surface material.

## 2.2 COUNTERTOP MATERIALS

- A. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.
- B. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

- C. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
1. 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. Du Pont de Nemours, Inc.
    - b. Formica Corporation.
    - c. Wilsonart International.
  2. Type: Provide Standard Type unless Special Purpose Type is indicated.
  3. Warranty: 10 years.
  4. Colors and Patterns:
    - a. CT-1: Formica Everform Solid Surface 748 White Renew.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

END OF SECTION 12 36 61





## SECTION 22 05 11

### COMMON WORK RESULTS FOR PLUMBING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

A. The requirements of this Section shall apply to all sections of Division 22.

B. Definitions:

1. Exposed: Piping and equipment exposed to view in finished rooms.

C. Abbreviations/Acronyms:

1. ABS: Acrylonitrile Butadiene Styrene
2. AISI: American Iron and Steel Institute
3. CDA: Copper Development Association
4. CO: Carbon Monoxide
5. CPVC: Chlorinated Polyvinyl Chloride
6. CWP: Cold Working Pressure
7. DWV: Drainage, Waste and Vent
8. EPDM: Ethylene Propylene Diene Monomer
9. ETO: Ethylene Oxide
10. FD: Floor Drain
11. FG: Fiberglass
12. FNPT: Female National Pipe Thread
13. FPM: Fluoroelastomer Polymer
14. HDPE: High Density Polyethylene
15. ID: Inside Diameter
16. MAWP: Maximum Allowable Working Pressure
17. NPTF: National Pipe Thread Female
18. NPS: Nominal Pipe Size
19. NPT: National Pipe Thread
20. OD: Outside Diameter
21. OSD: Open Sight Drain
22. OS&Y: Outside Stem and Yoke
23. PVC: Polyvinyl Chloride

##### 1.2 APPLICABLE PUBLICATIONS

A. The publications listed below shall 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):

- ASME Boiler and Pressure Vessel Code -  
BPVC Section IX-2013.....Welding, Brazing, and Fusing Qualifications
- B31.1-2012.....Power Piping



- C. American Society for Testing and Materials (ASTM):
  - A36/A36M-2012.....Standard Specification for Carbon Structural Steel
  - A575-96(R2013)e1 .....Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades
  - E84-2013a.....Standard Test Method for Surface Burning Characteristics of Building Materials
  - E119-2012a.....Standard Test Methods for Fire Tests of Building Construction and Materials
  - F1760-01(R2011).....Standard Specification for Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
  
- D. International Code Council, (ICC):
  - IBC-2012.....International Building Code
  
- E. Manufacturers Standardization Society (MSS) of the Valve and Fittings Industry, Inc:
  - SP-58-2009 .....Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application and Installation
  - SP-69-2003 .....Pipe Hangers and Supports - Selection and Application
  
- F. National Fire Protection Association (NFPA):
  - 51B-2014.....Standard for Fire Prevention During Welding, Cutting and Other Hot Work
  - 54-2012 .....National Fuel Gas Code
  - 70-2011 .....National Electrical Code (NEC)
  
- G. NSF International (NSF):
  - 5-2012 .....Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
  - 14-2012 .....Plastic Piping System Components and Related Materials
  - 61-2012 .....Drinking Water System Components – Health Effects
  - 372-2011 .....Drinking Water System Components – Lead Content

### 1.3 SUBMITTALS

- A. Contractor shall make all necessary field measurements and investigations to assure that the equipment and assemblies will meet contract requirements and will fit the space available.
  
- 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. Manufacturer's Literature and Data: Manufacturer's literature shall be submitted under the pertinent section rather than under this section.
  - 1. Equipment and materials identification.



2. Firestopping materials.
  3. Hangers, inserts, supports and bracing. Provide load calculations for variable spring and constant support hangers.
  4. Wall, floor, and ceiling plates.
- D. Submittals and shop drawings for interdependent items, containing applicable descriptive information, shall be furnished together and complete in a group. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient installation. Final review and approvals will be made only by groups.
- E. 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.

#### 1.4 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 22 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 by persons standing at floor level, or standing on permanent platforms, without the use of portable ladders. Examples of these items include, but are not limited to; all types of valves, filters and strainers, transmitters, and control devices.
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. Plumbing Systems: Unless otherwise required herein, perform plumbing work in accordance with the latest version of the Maine Uniform Plumbing Code.
- D. 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 Owner. All piping shall be tested in accordance with the specifications and the Maine Uniform Plumbing Code. 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.

## 1.5 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 Owner 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. Damaged equipment shall be replaced with an identical unit as determined and directed by the Engineer. Such replacement shall be at no additional cost or additional time to the Owner.
  - 3. Interiors of new equipment and piping systems shall be protected against entry of foreign matter. Both inside and outside shall be cleaned before painting or placing equipment in operation.

## 1.6 PERMITS, INSPECTIONS, AND CODES

- A. The installation shall be in full compliance with all local codes regarding all plumbing installations in effect at the site location and regulations of any other agency having jurisdiction and with the regulations of the State of Maine Plumbing Code.
- B. Conflicts arising between the plans and/or specifications with codes or local ordinances, the Plumbing Contractor shall submit these conflicts to the Architect/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 Plumbing Contractor's expense.
- C. The Plumbing Contractor shall acquire and pay for all permits and inspections as relating to scope of work for completion of all plumbing work as indicated on the drawings and herein with these specifications.



D. After completion of the work, the Contractor shall furnish to the Architect/Engineer for the Owner, a certificate of final inspection and acceptance from the inspector having jurisdiction.

## 1.7 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.

## 1.8 COORDINATION

A. The Plumbing 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.

## 1.9 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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS FOR VARIOUS SERVICES

- A. Plastic pipe, fittings and solvent cement shall meet NSF 14 and shall bear the NSF seal "NSF-PW". Polypropylene pipe and fittings shall comply with NSF 14 and NSF 61.
- B. 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 61 or NSF 372.
- C. In-line devices such as water meters, building valves, check valves, stops, valves, fittings, tanks and backflow preventers shall comply with NSF 61 and NSF 372.
- D. End point devices such as drinking fountains, lavatory faucets, kitchen and bar faucets, ice makers supply stops, and end-point control valves used to dispense drinking water must meet requirements of NSF 61 and NSF 372.

### 2.2 FACTORY-ASSEMBLED PRODUCTS

- A. Standardization of components shall be maximized 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 at no additional cost or time to the Owner.
- 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, shall be the same make and model.

### 2.3 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.

### 2.4 PIPE AND EQUIPMENT SUPPORTS AND RESTRAINTS

- A. For Attachment to Concrete Construction:
1. Concrete insert: Type 18, MSS SP-58.
  2. Self-drilling expansion shields and machine bolt expansion anchors: Permitted in concrete not less than 4 inches thick when approved by the Engineer for each job condition.
  3. Power-driven fasteners: Permitted in existing concrete or masonry not less than 4 inches thick when approved by the Engineer for each job condition.
- B. For Attachment to Steel Construction: MSS SP-58.
1. Welded attachment: Type 22.
  2. Beam clamps: Types 20, 21, 28 or 29. Type 23 C-clamp may be used for individual copper tubing up to 7/8 inch outside diameter.
- C. For Attachment to Wood Construction: Wood screws or lag bolts.
- D. Hanger Rods: Hot-rolled steel, ASTM A36/A36M or ASTM 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.
- E. Multiple (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.
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 insulated calcium silicate shield for insulated piping at each hanger.

- F. Pipe Hangers and Supports: (MSS SP-58), use hangers sized to encircle insulation on insulated piping. Refer to Section 22 07 11, Plumbing Insulation for insulation thickness. To protect insulation, provide Type 39 saddles for roller type supports or insulated calcium silicate shields. Provide Type 40 insulation shield or insulated calcium silicate shield at all other types of supports and hangers including those for insulated piping.
1. General Types (MSS SP-58):
    - a. Standard clevis hanger: Type 1; provide locknut.
    - b. Riser clamps: Type 8.
    - c. Wall brackets: Types 31, 32 or 33.
    - d. Roller supports: Type 41, 43, 44 and 46.
    - e. Saddle support: Type 36, 37 or 38.
    - f. Turnbuckle: Types 13 or 15.
    - g. U-bolt clamp: Type 24.
    - h. Copper Tube:
      - 1) Hangers, clamps and other support material in contact with tubing shall be painted with copper colored epoxy paint, copper-coated, plastic coated or taped with isolation tape to prevent electrolysis.
      - 2) For vertical runs use epoxy painted, copper-coated or plastic coated riser clamps.
      - 3) For supporting tube to strut: Provide epoxy painted pipe straps for copper tube or plastic inserted vibration isolation clamps.
  2. Plumbing Piping (Other Than General Types):
    - a. Horizontal piping: Type 1, 5, 7, 9, and 10.
    - b. Chrome plated piping: Chrome plated supports.
    - c. Hangers and supports in pipe chase: Prefabricated system ABS self-extinguishing material, not subject to electrolytic action, to hold piping, prevent vibration and compensate for all static and operational conditions.
    - d. Blocking, stays and bracing: Angle iron or preformed metal channel shapes, 18 gage minimum.

## 2.5 PIPE PENETRATIONS

- A. Pipe penetration sleeves shall be installed for all pipe other than rectangular blocked out floor openings for risers in mechanical bays.
- B. Pipe penetration sleeve materials shall comply with all firestopping requirements for each penetration.
- C. To prevent accidental liquid spills from passing to a lower level, provide the following:
  1. For sleeves: Extend sleeve 2 inch above finished floor and provide sealant for watertight joint.
  2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.



3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- D. Penetrations are not allowed through beams or ribs, but may be installed in concrete beam flanges, with structural engineer prior approval. Any deviation from these requirements must receive prior approval of Engineer.
- E. Sheet metal, plastic, or moisture resistant fiber sleeves shall be provided for pipe passing through floors, interior walls, and partitions, unless brass or steel pipe sleeves are specifically called for below.
- F. Cast iron or zinc coated pipe sleeves shall be provided for pipe passing through exterior walls below grade. The space between the sleeve and pipe shall be made watertight with a modular or link rubber seal. The link seal shall be applied at both ends of the sleeve.
- G. Galvanized steel or an alternate black iron pipe with asphalt coating sleeves shall be for pipe passing through concrete beam flanges, except where brass pipe sleeves are called for. A galvanized steel sleeve shall be provided for pipe passing through floor of mechanical rooms, laundry work rooms, and animal rooms above basement. Except in mechanical rooms, sleeves shall be connected with a floor plate.
- H. Brass Pipe Sleeves shall be provided for pipe passing through quarry tile, terrazzo or ceramic tile floors. The sleeve shall be connected with a floor plate.
- I. Sleeve clearance through floors, walls, partitions, and beam flanges shall be 1 inch greater in diameter than external diameter of pipe. Sleeve for pipe with insulation shall be large enough to accommodate the insulation plus 1 inch in diameter. Interior openings shall be caulked tight with firestopping material and sealant to prevent the spread of fire, smoke, water and gases.
- J. Sealant and Adhesives: Shall be an approved type for application.
- K. Pipe passing through roof shall be installed through a 4.9 kg per square meter copper flashing with an integral skirt or flange. Skirt or flange shall extend not less than 8 inches from the pipe and set in a solid coating of bituminous cement. Extend flashing a minimum of 10 inches up the pipe. Pipe passing through a waterproofing membrane shall be provided with a clamping flange. The annular space between the sleeve and pipe shall be sealed watertight.

## 2.6 TOOLS AND LUBRICANTS

- A. Furnish, and turn over to the Owner, special tools not readily available commercially, that are required for disassembly or adjustment of equipment and machinery furnished.

## 2.7 WALL, FLOOR AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit





tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.

- B. Thickness: Not less than 3/32 inch for floor plates. For wall and ceiling plates, not less than 0.025 inch)for up to 3 inch pipe, 0.035 inch for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls and ceilings in exposed locations, in finished areas only. Wall plates shall be used where insulation ends on exposed water supply pipe drop from overhead. A watertight joint shall be provided in spaces where brass or steel pipe sleeves are specified.

## 2.8 ASBESTOS

- A. Materials containing asbestos are not permitted.

## PART 3 - EXECUTION

### 3.1 ARRANGEMENT AND INSTALLATION OF EQUIPMENT AND PIPING

- A. Location of piping, sleeves, inserts, hangers, and equipment, access provisions shall be coordinated with the work of all trades. Piping, sleeves, inserts, hangers, and equipment shall be located clear of windows, doors, openings, light outlets, and other services and utilities.
- B. Manufacturer's published recommendations shall be followed for installation methods not otherwise specified.
- C. Operating Personnel Access and Observation Provisions: All equipment and systems shall be arranged to provide clear view and easy access, without use of portable ladders, for maintenance, testing and operation of all devices including, but not limited to all equipment items, valves, backflow preventers, filters, strainers, transmitters, sensors, meters and control devices. All gages and indicators shall be clearly visible by personnel standing on the floor or on permanent platforms. Maintenance and operating space and access provisions that are shown on the drawings shall not be changed nor reduced.
- D. Structural systems necessary for pipe and equipment support shall be coordinated to permit proper installation.
- E. Location of pipe sleeves, trenches and chases shall be accurately coordinated with equipment and piping locations.
- F. Cutting Holes:
  - 1. Holes shall be located to avoid interference with structural members such as beams or grade beams. Holes shall be laid out in advance and drilling done only after approval by General Contractor. If the Contractor considers it necessary to drill through structural members, this matter shall be referred to General Contractor for approval.



2. Waterproof membrane shall not be penetrated. Pipe floor penetration block outs shall be provided outside the extents of the waterproof membrane.
- G. Minor Piping: Generally, small diameter pipe runs from drips and drains, water cooling, and other service are not shown but must be provided.
- H. 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. Damaged or defective items in the opinion of the Owner/Engineer, shall be replaced at no additional cost or time to the Owner.
  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. Pipe openings, equipment, and plumbing fixtures shall be tightly covered against dirt or mechanical injury. At completion of all work thoroughly clean fixtures, exposed materials and equipment.
- I. Concrete and Grout: Concrete and shrink compensating grout 3000 psig minimum shall be used for all pad or floor mounted equipment.
- J. Gages, thermometers, valves and other devices shall be installed with due regard for ease in reading or operating and maintaining said devices. Thermometers and gages shall be located and positioned to be easily read by operator or staff standing on floor or walkway provided. Servicing shall not require dismantling adjacent equipment or pipe work.
- K. Work in bathrooms, restrooms, closets: All pipe penetrations behind escutcheons shall be sealed with plumber's putty.
- L. Switchgear Drip Protection: Every effort shall be made to eliminate the installation of pipe above data equipment, and electrical and telephone switchgear. If this is not possible, encase pipe in a second pipe with a minimum of joints. Drain valve shall be provided in low point of casement pipe.

### 3.2 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. Holes shall be drilled or burned in structural steel **ONLY** with the prior written approval of the General Contractor.
- B. The use of chain pipe supports, wire or strap hangers; wood for blocking, stays and bracing, or hangers suspended from piping above shall not be permitted. Rusty products shall be replaced.



- C. Hanger rods shall be used that are straight and vertical. Turnbuckles for vertical adjustments may be omitted where limited space prevents use. A minimum of 1/2 inch clearance between pipe or piping covering and adjacent work shall be provided.
- D. For horizontal and vertical plumbing pipe supports, refer to the Maine Uniform Plumbing Code and these specifications.
- E. 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, in addition to those shown, of adequate capability to support the imposed loads, located in accordance with the final approved layout of equipment and piping.
  - 3. Tubing and capillary systems shall be supported in channel troughs.
- F. Floor Supports:
  - 1. Provide concrete bases, concrete anchor blocks and pedestals, and structural steel systems for support of equipment and piping. Concrete bases and structural systems shall be anchored and doweled to resist forces under operating and seismic conditions (if applicable) without excessive displacement or structural failure.
  - 2. Bases and supports shall not be located and installed until equipment mounted thereon has been approved. Bases shall be sized to match equipment mounted thereon plus 2 inch excess on all edges. Structural drawings shall be reviewed for additional requirements. 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 grout material to permit alignment and realignment.

### 3.3 LUBRICATION

- A. All equipment and devices requiring lubrication shall be lubricated prior to initial operation. All devices and equipment shall be field checked for proper lubrication.
- B. All devices and equipment shall be equipped with required lubrication fittings. A minimum of one quart of oil and 1 pound of grease of manufacturer's recommended grade and type for each different application shall be provided. All materials shall be delivered 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.
- D. All lubrication points shall be extended to one side of the equipment.



### 3.4 CLEANING

- A. Prior to final inspection and acceptance of the Owner equipment and systems shall be thoroughly cleaned and painted.
- B. In addition, the following special conditions apply:
  - 1. Cleaning shall be thorough. Solvents, cleaning materials and methods recommended by the manufacturers shall be used for the specific tasks.

### 3.5 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.

### 3.6 OPERATION AND MAINTENANCE MANUALS

- A. All new equipment and all elements of each assembly shall be included.
- B. Manufacturer's installation, maintenance, repair, and operation instructions for each device shall be included. Assembly drawings and parts lists shall also be included. A summary of operating precautions and reasons for precautions shall be included in the Operations and Maintenance Manual.

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 05 11, Common Work Results for Plumbing, Article 1.3 Submittals for further requirements.
- C. See Section 22 05 11, Common Work Results for Plumbing, Article 1.4 Quality Assurance.

#### 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 +/- 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 53

### PLUMBING IDENTIFICATION

#### PART 1 - GENERAL

##### 1.01 RELATED DOCUMENTS

- A. Division 00 - Procurement and Contracting Requirements and applicable parts of Division 01 - General Requirements shall be included in and made a part of this Section.

##### 1.02 SUMMARY

- A. Section Includes:
  - 1. Equipment Markers
  - 2. Pipe Markers
  - 3. Duct Markers (Stencils)
  - 4. Ceiling Grid Markers
  - 5. Valve Tags
  - 6. Valve Tag Schedules
  - 7. Warning Signs, Labels, & Tags

##### 1.03 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 Schedules: For each piping system to include in maintenance manuals.

#### PART 2 - PRODUCTS

##### 2.01 MANUFACTURERS

- A. Brady World Wide Inc.
- B. Seton Identification Products
- C. Marking Services Inc.

##### 2.02 EQUIPMENT MARKERS

- A. Metal Labels for Equipment (Data Plate):



1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Letter Color: Black.
  3. Background Color: Natural metal.
  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 up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three quarters the size of principal lettering.
  6. Fasteners: Stainless steel self-tapping screws.
  7. Adhesive: Contact-type permanent adhesive, compatible with label and substrate.
- B. Custom Engraved Plastic Name Plates for Equipment (Equipment Tag):
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.
  2. Letter Color: White.
  3. Background Color: Black.
  4. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
  5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
  6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds to three quarters the size of principal lettering.
  7. Fasteners: Stainless steel self-tapping screws.
  8. Adhesive: Contact type permanent adhesive, compatible with label and substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment "tag" number, drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.
- D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2 by 11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

## 2.03 PIPE MARKERS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Self-Adhesive Pipe Labels: Printed plastic with contact type, permanent adhesive



backing.

- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; include arrow(s) indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Colors: Comply with ASME A13.1, unless otherwise indicated.
  - 3. Lettering Size: Size letters according to ASME A13.1 for piping.
- D. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive are not permitted on project.

#### 2.04 CEILING GRID MARKERS

- A. Ceiling Grid Markers: Brother P-Touch self-adhesive labels with printed equipment tag identification. Place labels under service access for above ceiling equipment

#### 2.05 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire link chain and S-hooks.
  - 3. Plastic and other combustible valve tag attachments are not permitted on the project.
- B. Valve Schedules: For each piping system, prepare dedicated valve tag schedule printed on 8 1/2 by 11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve tag schedule shall be included in operation and maintenance data.

#### 2.06 WARNING SIGNS, LABELS, AND TAGS

- A. Warning Signs and Labels
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16-inch thick, and having predrilled holes for attachment hardware.
  - 2. Letter Color: White.
  - 3. Background Color: Red.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 degrees F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.



6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two thirds to three quarters the size of principal lettering.
7. Fasteners: Stainless steel self-tapping screws.
8. Adhesive: Contact type permanent adhesive, compatible with label and substrate.
9. Label Content: Include caution and warning information plus emergency notification instructions.

#### B. Warning Tags

1. Description: Preprinted or partially preprinted accident-prevention tags of plasticized card stock with matte finish suitable for writing.
  - a. Size: Approximately 4 by 7 inches.
  - b. Fasteners: Brass grommet and wire.
  - c. Nomenclature: Large size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  - d. Color: Safety yellow background with black lettering.

### PART 3 - EXECUTION

#### 3.01 PREPARATION

- A. Clean piping and equipment surface of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

#### 3.02 GENERAL INSTALLATION 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.

#### 3.03 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

#### 3.04 PIPE LABEL INSTALLATION

- A. 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. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of 20 feet along each run. Reduce intervals to 5 feet in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- B. Directional Flow Arrows: Arrows shall be used to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.

C. Pipe Label Color Schedule:	<u>Background</u>	<u>Letter</u>
1. Low Pressure Compressed Air	Safety Blue	White
2. High Pressure Compressed Air	Safety Blue	White
3. Domestic Cold & Hot Water	Safety Green	White
4. Sanitary Drain, Waste, Vent, and Storm	Safety Green	White
5. Cooling Condensate	Safety Green	White

### 3.05 VALVE TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

### 3.06 WARNING TAG INSTALLATION

- A. Write required message on and attach warning tags to equipment where required.

END OF SECTION





## SECTION 22 07 11

### PLUMBING INSULATION

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for:
1. Plumbing piping 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 or piping handling media at design temperature of 60 degrees F or below.
  4. Concealed: Piping above ceilings and in chases pipe spaces.
  5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, unfinished attics, crawl spaces and pipe basements are not considered finished areas.
  6. FSK: Foil-scrim-kraft facing.
  7. Hot: Plumbing equipment or piping handling media above 105 degrees F.
  8. Density: Pcf - pounds per cubic foot.
  9. Thermal conductance: Heat flow rate through materials.
    - a. Flat surface: BTU per hour per square foot.
    - b. Pipe or Cylinder: BTU per hour per linear foot.
  10. Thermal Conductivity (k): BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
  11. Vapor Retarder (Vapor Barrier): A material which retards the transmission 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.
  12. RHW: Pump recirculation.
  13. CW: Cold water.
  14. SW: Soft water.
  15. HW: Hot water.
  16. PVDC: Polyvinylidene chloride vapor retarder jacketing, white.

##### 1.2 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, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 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.)
  - 4.3.3.3 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.
  - 4.3.10.2.6.3 Nonferrous fire sprinkler piping 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 5 feet or less when tested in accordance with UL 1887, Standard for Safety Fire Test of Plastic Sprinkler Pipe for Visible Flame and Smoke Characteristics.
  - 4.3.10.2.6.7 Smoke detectors shall not be required to meet the provisions of this section.
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. See Section 22 05 11, Common Work Results for Plumbing, Article 1.4 Quality Assurance.

### 1.3 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.
    - c. Insulation accessory materials: Each type used.
    - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
- B. See Section 22 05 11, Common Work Results for Plumbing, Article 1.3 Submittals for further requirements.



#### 1.4 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.

#### 1.5 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 basic designation only.
- B. Federal Specifications (Fed. Spec.):
  - L-P-535E (2)-91 .....Plastic Sheet (Sheeting): Plastic Strip; Poly (Vinyl Chloride) and Poly (Vinyl Chloride - Vinyl Acetate), Rigid.
- C. American Society for Testing and Materials (ASTM):
  - A167-04 .....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
  - C1126-10.....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



- E136-09 b.....Standard Test Methods for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C (1380 F)
- D. National Fire Protection Association (NFPA):  
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
- E. Underwriters Laboratories, Inc (UL):  
723.....UL Standard for Safety Test for Surface Burning Characteristics of Building Materials with Revision of 08/03
- F. Manufacturer's Standardization Society of the Valve and Fitting Industry (MSS):  
SP58-2002.....Pipe Hangers and Supports Materials, Design, and Manufacture

## PART 2 - PRODUCTS

### 2.1 FIBER GLASS

- A. ASTM C553 (Blanket, Flexible) Type I, Class B-3, Density 1 pcf,  $k = 0.31$  at 75 degrees F, for use at temperatures up to 400 degrees F.
- B. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation), Class 1,  $k = 0.26$  at 75 degrees F, for use at temperatures up to 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 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 as well as on interior piping exposed to outdoor air (i.e.; in ventilated attics, piping in ventilated (not air conditioned) spaces, etc.)in high humidity areas conveying fluids below ambient temperature. 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. Pipe fitting insulation covering (jackets): Fitting covering shall be premolded to match shape of fitting and shall be polyvinyl chloride (PVC), composition A, Type II Grade GU, and Type III, minimum thickness 0.03 inches. Provide color matching vapor retarder pressure sensitive tape.

## 2.4 MECHANICAL FASTENERS

- A. Pins, anchors: Welded pins, or metal or nylon anchors with galvanized steel or fiber washer, or clips. Pin diameter shall be as recommended by the insulation manufacturer.
- B. Staples: Outward clinching galvanized steel. 14 gage copper clad steel or nickel copper alloy.
- C. Bands: 1/2 inch nominal width, brass, galvanized steel, aluminum or stainless steel.

## 2.5 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 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 all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe 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 barrier 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 cold water pumps 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. Plumbing work not to be insulated:
  - 1. Piping and valves of fire protection system.
  - 2. Chromium plated brass piping.
  - 3. Water piping in contact with earth.
  - 4. Small horizontal cold water branch runs in partitions to individual fixtures may be without insulation for maximum distance of 3 feet.
  - 5. Distilled water piping.
- 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. Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.
- K. Firestop Pipe insulation:
  - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.
  - 2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions





- L. Freeze protection of above grade outdoor piping (overheat tracing tape): 0.75 thick insulation, for all pipe sizes 3 inches and smaller and 1 inch thick insulation for larger pipes. Provide metal jackets for all pipes. Provide for cold water make-up where indicated on the drawings as described in Section 23 21 13, Hydronic Piping (electrical heat tracing systems).
- M. Provide vapor barrier jackets over insulation as follows:
  - 1. All piping exposed to outdoor weather.
  - 2. All interior piping conveying fluids exposed to outdoor air (i.e. in attics, ventilated (not air conditioned) spaces, etc.) below ambient air temperature in high humidity areas.

### 3.2 INSULATION INSTALLATION

#### A. Molded Mineral Fiber Pipe and Tubing Covering:

- 1. Fit insulation to pipe, 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.

#### B. 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 22 05 11, Common Work Results for Plumbing.
  - 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.

### 3.3 INDOOR PIPING INSULATION SCHEDULE

#### A. Domestic Cold Water:

1. NPS 1 and Smaller: Insulation shall be the following:
  - a. Flexible Elastomeric: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
  - a. Flexible Elastomeric: 1 inch thick.
3. Vapor Barrier: Required.

#### B. Domestic Hot Water and Recirculated Hot Water:

1. NPS 1 and Smaller: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1/2 inch thick.
2. NPS 1-1/4 and Larger: Insulation shall be the following:
  - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
3. Vapor Barrier: Not Required.

END OF SECTION



## SECTION 22 11 00

### DOMESTIC WATER SYSTEM

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Domestic water systems, including piping, equipment and all necessary accessories as designated in this section.

##### 1.2 RELATED WORK

- A. Section 22 05 11, Common Work Results for Plumbing.

##### 1.3 SUBMITTALS

- A. Manufacturer's Literature and Data:
  - 1. All items listed in Part 2 - Products.
- B. See Section 22 05 11, Common Work Results for Plumbing, Article 1.3 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. American National Standards Institute (ANSI):
  - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
  - A13.1.....Scheme for Identification of Piping Systems
  - B16.3-2011.....Malleable Iron Threaded Fittings Classes 150 and 300
  - B16.9-2007.....Factory-Made Wrought Butt Welding Fittings
  - B16.11-2011.....Forged Fittings, Socket-Welding and Threaded
  - B16.12-2009 .....Cast Iron Threaded Drainage Fittings
  - B16.15-2006 .....Cast Copper Alloy Threaded Fittings Classes 125 and 250
  - B16.18-2001 (R2005) .....Cast Copper Alloy Solder-Joint Pressure Fittings
  - B16.22-2012.....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
  - B16.51-2011.....Copper and Copper Alloy Press-Connect Fittings
  - NSF/ANSI 61-2012 .....Drinking Water System Components - Health Effects
- C. American Society for Testing and Materials (ASTM):
  - A47/A47M-99(2009) .....Ferritic Malleable Iron Castings
  - A53/A53M-12.....Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless
  - A183-03(2009).....Carbon Steel Track Bolts and Nuts



- A269-10.....Seamless and Welded Austenitic Stainless Steel Tubing for General Service
- A312/A312M-12.....Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes
- A403/A403M-12.....Wrought Austenitic Stainless Steel Piping Fittings
- A536-84(2009).....Ductile Iron Castings
- A733-03(2009)e1 .....Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
- B32-08.....Solder Metal
- B61-08.....Steam or Valve Bronze Castings
- B62-09.....Composition Bronze or Ounce Metal Castings
- B75/B75M-11 .....Seamless Copper Tube
- B88-09.....Seamless Copper Water Tube
- B584-12a.....Copper Alloy Sand Castings for General Applications
- B687-99(2011).....Brass, Copper, and Chromium-Plated Pipe Nipples
- D1785-12 .....Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2000-12 .....Rubber Products in Automotive Applications
- D4101-11 .....Propylene Plastic Injection and Extrusion Materials
- D2564-04(2009) e1 .....Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- E1120-08.....Liquid Chlorine
- E1229-08.....Calcium Hypochlorite
  
- D. American Water Works Association (AWWA):
  - C110/A21.10-12.....Ductile Iron and Gray Iron
  - C151/A21.51-09.....Ductile-Iron Pipe, Centrifugally Cast
  - C153/A21.53-11.....Ductile-Iron Compact Fittings
  - C203-08.....Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
  - C213-07.....Fusion Bonded Epoxy Coating for the Interior & Exterior of Steel Water Pipelines
  - C651-05.....Disinfecting Water Mains
  
- E. American Welding Society (AWS):
  - A5.8/A5.8M-2011 .....Filler Metals for Brazing
  
- F. American Society of Sanitary Engineers (ASSE):
  - ANSI/ASSE 1001-2008 .....Pipe Applied Atmospheric Type Vacuum Breakers
  - ANSI/ASSE 1010-2004 .....Water Hammer Arresters
  - ANSI/ASSE 1018-2001 .....Trap Seal Primer Valves – Potable Water Supplied
  - ANSI/ASSE 1020-2004 .....Pressure Vacuum Breaker Assembly
  
- G. International Code Council (ICC)
  - ICC IPC (2012) .....International Plumbing Code
  
- H. 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

- I. Plumbing and Drainage Institute (PDI):  
PDI WH-201 2010 .....Water Hammer Arrestor

1.5 QUALITY ASSURANCE

- A. Unless otherwise indicated, the materials to be furnished under this contract shall be standard products of manufacturers regularly engaged in the production of such equipment and shall be the manufacturer's latest standard design that complies with the specification requirements.
- B. See Section 22 05 11, Common Work Results for Plumbing, Article 1.4 Quality Assurance.

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.

2.4 ABOVE GROUND (INTERIOR) WATER PIPING

- A. Pipe: Copper tube, ASTM B88, Type L, drawn. For pipe 6 inches and larger, stainless steel, ASTM A312, schedule 10 shall be used.
- B. Fittings for Copper Tube:
  - 1. Wrought copper or bronze castings conforming to ANSI B16.18 and B16.22. Unions shall be bronze, MSS SP72 & SP 110, Solder or braze joints. Use 95/5 tin and antimony for all soldered joints.
- D. Adapters: Provide adapters for joining screwed pipe to copper tubing.
- E. Solder: ASTM B32 Composition Sb5 HA or HB. Provide non-corrosive flux.
- F. Brazing alloy: AWS A5.8, Classification BCuP.

2.4 EXPOSED WATER PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed water piping connecting fixtures.



1. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish.
2. Nipples: ASTM B 687, Chromium-plated.
3. Unions: Brass or Bronze with chrome finish. Unions 2-1/2 inches and larger shall be flange type with approved gaskets.
4. Valves on exposed water piping in toilets shall be chromium plated brass or bronze.

## 2.5 TRAP PRIMER WATER PIPING:

- A. Pipe: Copper tube, ASTM B88, type K, hard drawn.
- B. Fittings: Bronze castings conforming to ANSI B16.18 Solder joints.
- C. Solder: ASTM B32 composition Sb5. Provide non-corrosive flux.

## 2.6 STRAINERS

- A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
- B. Water: Basket or "Y" type with easily removable cover and brass strainer basket.
- C. Body: Smaller than 3 inches, brass or bronze; 3 inches and larger, cast iron or semi-steel.

## 2.7 WATER HAMMER ARRESTER:

- A. Closed copper tube chamber with permanently sealed 60 psig air charge above a Double O-ring piston. Two high heat Buna-N O-rings pressure packed and lubricated with FDA approved silicone compound. All units shall be designed in accordance with ASSE 1010 for sealed wall installations without an access panel. Size and install in accordance with Plumbing and Drainage Institute requirements (PDI-WH 201). Provide water hammer arrestors at:
  1. All solenoid valves.
  2. All groups of two or more flush valves.
  3. All quick opening or closing valves.

# PART 3 - EXECUTION

## 3.1 INSTALLATION

- A. General: Comply with the International Plumbing Code and the following:
  1. Install branch piping for water from the piping system and connect to all fixtures, valves, cocks, outlets, and equipment.
  2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
  3. All pipe runs shall be laid out to avoid interference with other work. Piping shall run as high and as close as possible and parallel to the walls, or as shown.



4. Install union and shut-off valve on pressure piping at connections to equipment.
  5. Pipe Hangers, Supports and Accessories:
    - a. All piping shall be supported per the International Plumbing Code.
    - b. Floor, Wall and Ceiling Plates, Supports, Hangers:
      - 1) Solid or split un-plated cast iron.
      - 2) All plates shall be provided with set screws.
      - 3) Pipe Hangers: Height adjustable clevis type.
      - 4) Adjustable Floor Rests and Base Flanges: Steel.
      - 5) Concrete Inserts: "Universal" or continuous slotted type.
      - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
      - 7) Riser Clamps: Malleable iron or steel.
      - 8) Rollers: Cast iron.
      - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
      - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180-degree (min.) metal protection shield Centered on and secured to the hanger and support. The shield shall be 4 inches in length and be 16-gauge steel. The shield shall be sized for the insulation.
  6. Install chrome plated cast brass escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations.
  7. Penetrations:
    - a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
    - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with an approved sealant.
- B. Piping shall conform to the following:
1. Domestic Water:
    - a. Grade all lines to facilitate drainage. Provide drain valves at bottom of risers and all low points in system. Design domestic hot water circulating lines with no traps.
    - b. Connect branch lines at bottom of main serving fixtures below and pitch down so that main may be drained through fixture. Connect branch lines to top of main serving only fixtures located on floor above.
    - c. No plumbing fixtures, devices, or piping shall be installed which will provide a cross or inter-connection between a distributing supply for a drinking water system or domestic water system and a polluted supply or drainage system or plant water system.
    - d. No water pipe shall be installed outside of the building or in an exterior wall unless adequate provision is made to protect such pipe from freezing.



### 3.2 TESTS

- A. Domestic Water System: Test after installation of piping and domestic water heaters, but before piping is concealed, before covering is applied, and before plumbing fixtures are connected. Fill systems with water and maintain hydrostatic pressure of 150 psi gage for two hours. No decrease in pressure is allowed. Provide a pressure gage with a shutoff and bleeder valve at the highest point of the piping being tested.

### 3.3 DOMESTIC HOT WATER SYSTEM

- A. The main hot water system shall include connecting hot water and cold water piping to hot water heater as shown on plans, hot water supply mains with risers and branches to all fixtures and equipment.
- B. Hot water piping shall be kept at least 6 inches away from cold water lines.
- C. Provide suitable means for thermal expansion for all hot water piping, using swing joints, expansion loops and long offsets, as required.
- D. Vent all high points in the hot water system. All hot water piping shall be pitched up toward fixtures and risers for proper air relief. (Fixture supplies shall be considered vents.)
- E. Provide a suitable means to protect all water piping from water hammer.

END OF SECTION





## SECTION 22 13 00

### FACILITY SANITARY AND VENT PIPING

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section.
- 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):
  - A13.1-2007 .....Scheme for the Identification of Piping Systems
  - A112.36.2M-1991(R 2012) ...Cleanouts
  - A112.6.3-2001 (R2007) .....Standard for Floor and Trench Drains
  - B1.20.1-2013.....Pipe Threads, General Purpose (Inch)
  - B16.1-2010.....Gray Iron Pipe Flanges and Flanged Fittings
  - B16.4-2011.....Standard for Grey Iron Threaded Fittings Classes 125 and 250
  - B16.15-2013.....Cast Copper Alloy Threaded Fittings, Classes 125 and 250
  - B16.18-2012.....Cast Copper Alloy Solder Joint Pressure Fittings
  - B16.21-2011.....Nonmetallic Flat Gaskets for Pipe Flanges
  - B16.22-2013.....Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings
  - B16.23-2011.....Cast Copper Alloy Solder Joint Drainage Fittings: DWV
  - B16.24-2001 (R2006) .....Cast Copper Alloy Pipe Flanges and Flanged Fittings
  - B16.29-2012.....Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings: DWV
  - B16.39-2009.....Malleable Iron Threaded Pipe Unions Classes 150, 250, and 300
  - B18.2.1-2012 .....Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series)
- C. American Society of Sanitary Engineers (ASSE):
  - 1001-2008 .....Performance Requirements for Atmospheric Type Vacuum Breakers
  - 1018-2001 .....Performance Requirements for Trap Seal Primer Valves – Potable Water Supplied



- 1044-2001 .....Performance Requirements for Trap Seal Primer Devices  
– Drainage Types and Electronic Design Types
- 1079-2012 .....Performance Requirements for Dielectric Pipe Unions

D. American Society for Testing and Materials (ASTM):

- A53/A53M-2012.....Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless
- A74-2013a.....Standard Specification for Cast Iron Soil Pipe and Fittings
- A888-2013a.....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- B32-2008.....Standard Specification for Solder Metal
- B43-2009.....Standard Specification for Seamless Red Brass Pipe, Standard Sizes
- B75-2011.....Standard Specification for Seamless Copper Tube
- B88-2009.....Standard Specification for Seamless Copper Water Tube
- B306-2013.....Standard Specification for Copper Drainage Tube (DWV)
- B584-2013.....Standard Specification for Copper Alloy Sand Castings for General Applications
- B687-1999 (R 2011) .....Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
- B813-2010.....Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
- B828-2002 (R 2010) .....Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
- C564-2012.....Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- D1785-2012 .....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
- D2321-2011 .....Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
- D2564-2012 .....Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
- D2665-2012 .....Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- D2855-1996 (R 2010) .....Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
- D5926-2011 .....Standard Specification for Poly(Vinyl Chloride) (PVC) Gaskets for Drain, Waste, and Vent (DWV), Sewer, Sanitary, and Storm Plumbing Systems
- F402-2005 (R 2012).....Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings
- F477-2010 .....Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
- F1545-1997 (R 2009).....Standard Specification for Plastic-Lined Ferrous Metal Pipe, Fittings, and Flanges



- E. Cast Iron Soil Pipe Institute (CISPI):
  - 2006 .....Cast Iron Soil Pipe and Fittings Handbook
  - 301-2012 .....Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
  - 310-2012 .....Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
  
- F. Copper Development Association, Inc. (CDA):
  - A4015.....Copper Tube Handbook
  
- G. Uniform Plumbing Code (UPC):
  - UPC-2015
  
- H. Manufacturers Standardization Society (MSS):
  - SP-123-2013 .....Non-Ferrous Threaded and Solder-Joint Unions for Use With Copper Water Tube
  
- I. National Fire Protection Association (NFPA):
  - 70-2011 .....National Electrical Code (NEC)
  
- J. Plumbing and Drainage Institute (PDI):
  - WH-201 (R 2010) .....Water Hammer Arrestors Standard
  
- K. Underwriters' Laboratories, Inc. (UL):
  - 508-99 (R2013).....Standard For Industrial Control Equipment

### 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. Piping.
  - 2. Floor Drains.
  - 3. Grease Removal Unit.
  - 4. Cleanouts.
  - 5. Trap Seal Protection.
  - 6. Penetration Sleeves.
  - 7. Pipe Fittings.
  - 8. Traps.
  - 9. Exposed Piping and Fittings.
  
- B. See Section 22 05 11, Common Work Results for Plumbing, Article 1.3 Submittals for further requirements.



- C. See Section 22 05 11, Common Work Results for Plumbing, Article 1.4 Quality Assurance.

## PART 2 - PRODUCTS

### 2.1 SANITARY WASTE, DRAIN, AND VENT PIPING

#### A. Copper Tube, (DWV):

1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME B16.29.
4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

#### B. Polyvinyl Chloride (PVC)

1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 140 degrees F.
2. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be solid core sewer piping conforming to ASTM D2665, sewer and drain series with ends for solvent cemented joints.
3. Fittings: PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

### 2.2 SPECIALTY PIPE FITTINGS

- #### A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:

1. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F477 or ASTM D5926.
2. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.

### 2.3 CLEANOUTS

- #### A. Cleanouts shall be the same size as the pipe, up to 4 inches; and not less than 4 inches for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 24 inches shall be provided for clearing a clogged sanitary line.
- #### B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or



bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 2 inches. When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.

- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 24 inches above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 6 by 6 inches shall be furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

## 2.4 FLOOR DRAINS

- A. As Scheduled on Drawings.

## 2.5 TRAPS

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be material as the piping they are connected to. Slip joints are not permitted on sewer side of trap. Traps shall be as required by connected service or fixture.

## 2.6 PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

- A. Trap Primer: The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 125 psig and conforming to standard ASSE 1018.
  1. The inlet and outlet connections shall be DN15 (NPS 1/2 inch)
  2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
  3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
  4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
  5. The manifold shall be omitted when serving only one trap.



## PART 3 - EXECUTION

### 3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the Uniform Plumbing Code (UPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, and equipment.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. The piping shall be installed free of sags and bends.
- H. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- I. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- J. Aboveground copper tubing shall be installed according to Copper Development Association's (CDA) "Copper Tube Handbook".
- K. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.
- L. If an installation is unsatisfactory to the Engineer, the Contractor shall correct the installation at no cost to the Owner.



### 3.2 JOINT CONSTRUCTION

- A. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service.
  - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- B. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.
- C. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

### 3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

### 3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, Common Work Results for Plumbing, and these specifications. Where conflicts arise between these the code and Section 22 05 11, Common Work Results for Plumbing the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Horizontal piping and tubing shall be supported within 12 inches of each fitting or coupling.
- C. The maximum spacing for plastic pipe shall be 4 feet.
- D. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 15 feet.
- E. In addition to the requirements in Section 22 05 11, Common Work Results for Plumbing, Floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
  - 1. Solid or split unplated cast iron.
  - 2. All plates shall be provided with set screws.



3. Height adjustable clevis type pipe hangers.
  4. Adjustable floor rests and base flanges shall be steel.
  5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
  6. Riser clamps shall be malleable iron or steel.
  7. Rollers shall be cast iron.
- F. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- G. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
  2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with approved sealant.
- H. Sanitary vents shall not connect to exhaust vents.

### 3.5 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
- B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 10 foot head of water. In testing successive sections, test at least upper 10 feet of next preceding section so that each joint or pipe except upper most 10 feet of system has been submitted to a test of at least a 10 foot head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
  2. For an air test, an air pressure of 5 psig gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
  3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.

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 22 05 11, Common Work Results for Plumbing, Article 1.3 Submittals for further requirements.
- C. See Section 22 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 for 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 22 60 05

### MEDICAL AIR, GAS, AND VACUUM SYSTEMS

#### PART 1 – GENERAL

##### 2.1 SECTION INCLUDES

- A Pipe and fittings.
- B Valves and regulators.
- C Piping accessories.

##### 2.2 RELATED REQUIREMENTS

- A Section 22 05 53 - Identification for Plumbing Piping and Equipment

##### 2.3 REFERENCE STANDARDS

- A ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings 2021.
- B ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings 2021.
- C ASTM B88 - Standard Specification for Seamless Copper Water Tube 2020.
- D ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric) 2020.
- E ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- F ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2021.
- G ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.
- H AWS A5.8M/A5.8 - Specification for Filler Metals for Brazing and Braze Welding 2019.



- I MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation 2018, with Amendment (2019).
- J NFPA 99 - Health Care Facilities Code 2021, with Amendment.
- K UL (DIR) - Online Certifications Directory Current Edition

## 2.4 SUBMITTALS

- A Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
- B Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of control and alarm panels. Submit detailed medical wall assembly drawings.
- C Certificates: Certify that products meet or exceed specified requirements.
- D Independent Testing Agency Reports: Indicate systems are complete, zone valves installed, alarm systems functional, and pressure and cross connections tests performed. Document tests.
- E Manufacturer's Instructions: Indicate installation requirements for equipment and systems.
- F Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
- G Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

## 2.5 QUALITY ASSURANCE

- A Select products and execute work in compliance with NFPA 99 and UPC.
- B Products Requiring Electrical Connection: Listed and classified by UL (DIR) as suitable for the purpose specified and indicated.



## 2.6 WARRANTY

- A See Section 017800 - Closeout Submittals for additional warranty requirements.

## PART 2 – PRODUCTS

### 4.1 PIPE AND FITTINGS

- A Oxygen, Compressed Air, Nitrous Oxide, Nitrogen Systems, Aboveground:
  - 1. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), drawn.
  - 2. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper.
  - 3. Joints: AWS A5.8M/A5.8 Classification BCuP-3 or BCuP-4 silver braze.
- B Oral Evacuation Systems:
  - 1. PVC Pipe: ASTM D1785, PVC 1120 or 1220, Schedule 40.
  - 2. Fittings: ASTM D2466, PVC long radius or wye type.
  - 3. Joints: Solvent welded with ASTM D2564 cement
- C Cleanouts: Same size and material as pipe. Provide accessible and easily removable cleanouts as defined in Section 22 13 00, FACILITY SANITARY SEWERAGE
- D Apply piping identification per ANSI A13.1.

### 4.2 VALVES

- A Ball Valves (Oral Evacuation Systems Only):
  - 1. PVC body, double-seal ball valves with replaceable neoprene or teflon seat and stem seals, for minimum 100 psi (690 kPa) working pressure, designed especially for vacuum service.

### 4.3 PIPING ACCESSORIES

- A Hangers and Supports: MSS SP-58 with types as required.
- B Piping Identification: Pressure sensitive adhesive tape and decals, color and labeling to comply with Section 22 05 53.



## PART 3 – EXECUTION

### 6.1 INSTALLATION

- A Install in accordance with NFPA 99 applying system specific piping service font and tag colors.
- B Pre-Installation Cleaning: Disassemble positive pressure gas systems pipe, fittings, valves, and components, except those supplied cleaned and prepared for intended service, and thoroughly wash in hot solution of sodium carbonate or trisodium phosphate mixed 1 lb to 3 gal (1 kg to 25 L) of water. After washing, rinse with water, dry and cap until installation.
- C Braze joints in pipe and tubing. Avoid leaving excess flux inside of pipe and fittings. During brazing of pipe connections, purge interior of pipe continuously with nitrogen.
- D Effect changes in size with reducing fittings. Make changes in direction of required turns or offsets with fittings or tubing shaped by bending tools. Make bends free of flattening, buckling or thinning of tube wall
- E Cut pipe and tubing accurately and install without springing or forcing
- F Grade piping down in direction of flow.
- G Provide pipe sleeves where pipes and tubing pass through walls, floors, roofs, and partitions. Finish flush at both ends. Extend 2 inches (50 mm) above finished floors. Pack space between pipe or tubing and sleeve, and calk.
- H Identify piping with tape and decals. Provide piping identification code and schematic for installation under provisions of Section 22 05 53. Install labeling on pipe at intervals of not more than 20 feet (6 meters) and at least once in each room and each story traversed by pipeline.
- I Pipe Support – PVC: Space pipe hangers maximum 4 feet on center.





- J Pipe Support – COPPER TUBING; Space pipe hangers horizontally by pipe size or vertically as follows:
- |                                      |                     |
|--------------------------------------|---------------------|
| 1. 1/4 inch (8 mm, DN)               | 5 feet (1,520 mm).  |
| 2. 3/8 inch (10 mm, DN)              | 6 feet (1,830 mm).  |
| 3. 1/2 inch (15 mm, DN)              | 6 feet (1,830 mm).  |
| 4. 3/4 inch (20 mm, DN)              | 7 feet (2,130 mm).  |
| 5. 1 inch (25 mm, DN)                | 8 feet (2,440 mm).  |
| 6. 1-1/4 inch (32 mm, DN)            | 9 feet (2,740 mm).  |
| 7. 1-1/2 inch (40 mm, DN) and larger | 10 feet (3,050 mm). |
- K Provide vacuum pumps with water supply piped from potable water system. Provide reduced pressure back flow preventer on water supply.
- L Place vacuum producers on insulating pads furnished with the equipment. Do not bolt or anchor equipment to the floor slab.
- M All fittings shall be DWV (drain-waste-vent) long-radius bend types for turns and wye types for branching. For small bore piping for which long-radius bends are not available, two 45-degree bends shall be substituted for 90-degree turning.

## 6.2 PIPING SYSTEMS CLEANING AND PRESSURE TESTING

- A AIR: After erection of pipe and tubing but prior to installation of service outlet valves, blow systems clear of free moisture and foreign matter with nitrogen gas.
- B AIR: Install service outlet valves, subject system to test pressure of 150 psi nitrogen or dry compressed air. Check with soapy water. Provide 24-hour standing pressure test.
- C VACUUM: Pipe Leakage Test: Prior to concealing any vacuum piping, test system in accordance with NFPA 99 Section 5.1.12.2.7. Provide 24-hour standing vacuum test. Vacuum shall not decrease by more than 0.4 in. mercury. If the vacuum does not hold, repair the leaks and retest.

## 6.3 FIELD QUALITY CONTROL

- A Reduce pressure in piping systems other than system under investigation to atmospheric.
- B Disconnect test gas and connect proper gas to each system. Purge entire system to remove test gas. Check with analyzer suitable for gas installed.

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 23 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. Coordinate and properly integrate materials and equipment in each group to provide a completely compatible and efficient.
- 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 Architect/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 Architect/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.

## 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 VARIABLE SPEED MOTOR CONTROLLERS

- A. Refer to Section 26 05 11, Requirements for Electrical Installations.
- B. The combination of controller and motor shall be provided by the manufacturer of the driven equipment, such as pumps and fans, and shall be rated for 100 percent output performance. Multiple units of the same class of equipment, i.e. air handlers, fans, pumps, shall be product of a single manufacturer.
- C. The controller-motor combination shall be guaranteed to provide full motor nameplate horsepower in variable frequency operation. Both driving and driven motor/fan sheaves shall be fixed pitch.
- D. Controller shall not add any current or voltage transients to the input AC power distribution system, DDC controls, etc., nor shall be affected from other devices on the AC power system.

## 2.5 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. Converter and Expansion Tank Hangers: May be Type 1 sized for the shell diameter. Insulation where required will cover the hangers.

## 2.6 PIPE PENETRATIONS

- A. Install sleeves during construction for other than blocked out floor openings for risers in mechanical bays.
  
- B. To prevent accidental liquid spills from passing to a lower level, provide the following:
  - 1. For sleeves: Extend sleeve one inch above finished floor and provide sealant for watertight joint.
  - 2. For blocked out floor openings: Provide 1-1/2 inch angle set in silicone adhesive around opening.
  - 3. For drilled penetrations: Provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
  
- C. Penetrations are not allowed through beams. Any deviation from these requirements must receive prior approval of General Contractor.
  
- D. 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.
  
- E. 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.



- F. Brass Pipe Sleeves: Provide for pipe passing through quarry tile, terrazzo or ceramic tile floors. Connect sleeve with floor plate.
- G. 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.
- H. Sealant and Adhesives: Shall be an approved type suitable for construction type.

## 2.7 DUCT PENETRATIONS

- A. Provide curbs for roof mounted piping, ductwork, and equipment. Curbs shall be 18 inches high with continuously welded seams, built-in cant strip, interior baffle with acoustic insulation, curb bottom, hinged curb adapter.
- B. Provide an approved means of firestopping for openings through fire and smoke barriers, maintaining minimum required rating of floor, ceiling, or wall assembly.

## 2.8 WALL, FLOOR, AND CEILING PLATES

- A. Material and Type: Chrome plated brass or chrome plated steel, one piece or split type with concealed hinge, with set screw for fastening to pipe, or sleeve. Use plates that fit tight around pipes, cover openings around pipes and cover the entire pipe sleeve projection.
- B. Thickness: Not less than 3/32-inch for floor plates. For wall and ceiling plates, not less than 0.025-inch for up to 3-inch pipe, 0.035-inch for larger pipe.
- C. Locations: Use where pipe penetrates floors, walls, and ceilings in exposed locations, in finished areas only. Provide a watertight joint in spaces where brass or steel pipe sleeves are specified.

## 2.9 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 MOTOR AND DRIVE ALIGNMENT

- A. Belt Drive: Set driving and driven shafts parallel and align so that the corresponding grooves are in the same plane.
- B. Direct-connect Drive: Securely mount motor in accurate alignment so that shafts are free from both angular and parallel misalignment when both motor and driven machine are operating at normal temperatures.

### 3.7 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.

### 3.8 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 19

### METERS AND GAUGES FOR HVAC PIPING

#### PART 1 - GENERAL

##### 1.1 SUMMARY

###### A. Section includes:

1. Bimetallic-actuated thermometers
2. Liquid-in-glass thermometers
3. Duct-thermometer mounting brackets
4. Thermowells
5. Dial-type pressure gauges
6. Gauge attachments
7. Test plugs
8. Test-plug kits
9. Sight flow indicators

###### B. Related Requirements:

1. Refer to mechanical drawings for VAV box airflow measuring stations.
2. Refer to mechanical for AHU airflow measuring stations.

##### 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 ACTION SUBMITTALS

- ###### A. Product Data: For each type of product.

###### B. Shop Drawings:

1. Include diagrams for power, signal, and control wiring.

##### 1.4 INFORMATION SUBMITTALS

- ###### A. Product Certificates: For each type of meter and gauge.

- ###### B. Operation and Maintenance Data: For meters and gauges to include in operation and maintenance manuals.



## PART 2 - PRODUCTS

### 2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Standard: ASME B40.200
- B. Case: Liquid-filled and sealed type; stainless steel with 5-inch nominal diameter
- C. Dial: Non-reflective aluminum with permanently etched scale marking and scale in deg. F.
- D. Connector Type(s): Union joint, adjustable angle with unified-inch screw threads
- E. Connector Size: ½ inch, with ASME B1.1 screw threads
- F. Stem: 0.25 or 0.375 inch in diameter; stainless steel
- G. Window: Plain glass
- H. Ring: Stainless steel
- I. Element: Bimetal coil
- J. Pointer: Dark colored metal
- K. Accuracy: Plus, or minus 1 percent of scale range

### 2.2 LIQUID-IN-GLASS THERMOMETERS

- A. Metal-case, Compact-Style, Liquid-in-Glass Thermometers:
  - 1. Standard: ASME B40.200
  - 2. Case: Cast aluminum; 6-inch nominal size
  - 3. Case Form: Straight
  - 4. Tube: Glass with magnifying lens and blue or red organic liquid
  - 5. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg f.
  - 6. Window: Glass
  - 7. Stem: Aluminum or brass and of length to suit installation
    - i. Design for Air-Duct Installation: With ventilated shroud
    - ii. Design for Thermowell Installation: Bare stem
  - 8. Connector: ¾ inch with ASME B1.1 screw threads
  - 9. Accuracy: Plus, or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range



## 2.3 DUCT-THERMOMETER MOUNTING BRACKETS

- A. Description: Flanged bracket with screw holes, for attachment to air duct and made to hold thermometer stem

## 2.4 THERMOWELLS

### A. Thermowells:

1. Standard: ASME B40.200
2. Description: Pressure-tight, socket-type fitting made for insertion in piping tee fitting
3. Material for Use with Copper Tubing: CNR or CUNI
4. Material for Use with Steel Piping: CRES or CSA
5. Type: Stepped shank unless straight or tapered shank is indicated
6. External Threads: NPS  $\frac{1}{2}$ , NPS  $\frac{3}{4}$ , NPS 1 ASME B1.20.1 pipe threads
7. Internal Threads:  $\frac{1}{2}$ ,  $\frac{3}{4}$ , and 1, with ASME B1.1 screw threads
8. Bore: Diameter required to match thermometer bulb or stem
9. Insertion Length: Length required to match thermometer bulb or stem
10. Lagging Extension: Include on thermowells for insulated piping and tubing
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection

- B. Heat-Transfer Medium: Mixture of graphite and glycerin or manufacturers recommendation

## 2.5 DIAL-TYPE PRESSURE GAUGES

### A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gauges:

1. Standard: ASME B40.100
2. Case: Liquid-filled, Sealed type, cast aluminum or drawn steel; 4-1/2-inch nominal diameter
3. Pressure-Element Assembly: Burdon tube unless otherwise indicated.
4. Pressure Connection: Brass, with NPS  $\frac{1}{4}$  or NPS  $\frac{1}{2}$  ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
5. Movement: Mechanical, with link to pressure element and connection to pointer
6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi
7. Pointer: Dark-colored metal
8. Window: Glass
9. Ring: Stainless steel
10. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range



## 2.6 GAUGE ATTACHMENTS

- A. Siphons: Loop-shaped section of brass or steel pipe with NPS ¼ or NPS 1/3 pipe threads
- B. Valves: Brass ball, with NPS ¼ or NPS ½, ASME B1.20.1 pipe threads

## 2.7 TEST PLUGS

- A. Description: Test-station fitting made for insertion in piping tee fitting
- B. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping
- C. Thread Size: NPS ¼ or NPS 1/2, ASME B1.20.1 pipe thread
- D. Minimum Pressure and Temperature Rating: 500psig at 200 deg F
- E. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

## 2.8 TEST PLUG KITS

- A. Furnish one test-plug kit containing one thermometer, one pressure gauge and adapter, and carrying case. Thermometer sensing elements, pressure gauge, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- B. High-Range Thermometer: Small, bimetallic insertion type with 2-inch diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 200 deg F
- C. Pressure Gauge: Small, bourdon-tube insertion type with 2-to-3-inch diameter dial and probe
- D. Carrying Case: Metal or plastic, with formed instrument padding

## 2.9 SIGHT FLOW INDICATORS

- A. Description: Piping inline-installation device for visual verification of low
- B. Construction: Bronze or stainless-steel body, with sight glass and paddle wheel indicator, and threaded or flanged ends
- C. Minimum Pressure Rating: 125 psig
- D. Minimum Temperature Rating: 200 deg F



- E. End Connection for NPS 2 and Smaller: Threaded
- F. End Connection for NPS 2-1/2 and Larger: Flanged

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Install thermowells with socket extending to center of pipe and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushing 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 for operator readability.
- F. Install duct-thermometer mounting brackets in wall of ducts. Attach to duct with screw.
- G. Install direct-mounted pressure gauges in piping tees with pressure gauge located on pipe at the most readable position.
- H. Install valve and snubber in piping for each pressure gauge for fluids (except steam)
- I. Install thermometers in the following locations regardless of if shown on plans or not:
  - 1. Inlet and outlet of each hydronic boiler
  - 2. Inlet and outlet of each hydronic coil in air-handling units, HRV's and other air moving equipment
  - 3. Two inlets and two outlets of each hydronic heat exchanger
  - 4. Outside, return, supply, and mixed-air ducts
- J. Install pressure gauges in the following locations regardless of if shown on plans or not:
  - 1. Discharge of each pressure-reducing valve
  - 2. Two inlets and two outlets of each hydronic heat exchanger.
  - 3. Suction and discharge of each pump
  - 4. On expansion tanks



### 3.2 CONNECTIONS

- A. Install meters and gauges adjacent to machines and equipment to allow space for service and maintenance of meters, gauges, machines, and equipment.

### 3.3 ADJUSTING

- A. Adjust faces of meters and gauges to proper angle for best visibility.

### 3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each hydronic boiler shall be the following:
  - 1. Liquid-filled bimetallic-actuated type
- B. Thermometers at inlet and outlet of each hydronic coil in air-handling units, HRV's, and built-up central systems shall be the following:
  - 1. Liquid-filled bimetallic-actuated type
- C. Thermometers at inlets and outlets of each hydronic heat exchanger shall be the following:
  - 1. Liquid-filled bimetallic-actuated type
- D. Thermometers at outside, return, supply, and mixed-air ducts shall be the following:
  - 1. Compact-style, liquid-in-glass type
- E. Thermometer stems shall be of length to match thermowell insertion length.

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. All equipment in Division 23.

##### 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.
- D. Water Balance and Equipment Test: Include circulating pumps, baseboard, convectors, panel radiators, coils:
  - 1. Adjust flow rates for equipment. Set coils and evaporator to values on equipment submittals, if different from values on contract drawings.
  - 2. Primary-secondary (variable volume) systems: Coordinate TAB with Section 23 09 23, Direct-Digital Control System for HVAC. Balance systems at design water flow and then verify that variable flow controls function as designed.
  - 3. Record final measurements for hydronic equipment on performance data sheets. Include entering and leaving water temperatures for heating and cooling coils. Include entering and leaving air temperatures (DB/WB for cooling coils) for air handling units and reheat coils. Make air and water temperature measurements at the same time.

### 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 21 23, Hydronic Pumps
- C. Section 23 23 00, Refrigerant Piping: Requirements for refrigerant piping and fittings.
- D. Section 23 21 13, Hydronic Piping.
- E. 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  $k = 0.31$  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.

<b>Nominal Pipe Size and Accessories Material (Insert Blocks)</b>	
Nominal Pipe Size inches	Insert Blocks inches
Up through 5	6 long
6	6 long
8, 10, 12	9 long
14, 16	12 long
18 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.
  - 2. Exhaust air ducts, except for Condo Bathroom exhaust ducts.
  - 4. Equipment: Expansion tanks, hot water pumps.
  - 5. In hot water piping: Unions, flexible connectors, control valves, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 3 inches of uninsulated items.
  
- 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. Firestop Pipe and Duct insulation:
  - 1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed.
  - 2. Pipe and duct penetrations requiring fire stop insulation including, but not limited to the following:
    - a. Pipe risers through floors
    - b. Pipe or duct chase walls and floors
    - c. Smoke partitions
    - d. Fire partitions
  
- L. 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.
  
- M. 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.
  6. Laundry: Hot exhaust ducts from dryers and from ironers, where duct is exposed in the laundry.
- 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).
    - c. Chillers, insulate any cold chiller surfaces subject to condensation which has not been factory insulated.
    - 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 APPLICATION –BOILER PLANT, PIPE, VALVES, STRAINERS, AND FITTINGS

- A. Temperature range 251 to 450 degrees F;
  1. Application; Steam service 16 psig nominal and higher, high pressure condensate to trap assembly, boiler bottom blowoff from boiler to blowoff valve closest to boiler.
  2. Insulation and Jacket:
    - a. Calcium silicate for piping from zero to 6 feet above boiler room floor, feedwater heater mezzanine floor or access platform and any floors or platforms on which tanks or pumps are located.
    - b. Mineral fiber for remaining locations.
    - c. ASJ with PVC premolded fitting coverings.
    - d. Aluminum jacket from zero to 6 feet above floor on atomizing steam and condensate lines at boilers and burners.
3. Thickness:



Nominal Thickness of Calcium Silicate Insulation (Boiler Plant)	
Pipe Diameter (in)	Insulation Thickness (in)
1 and below	5
1-1/4 to 1-1/2	5
1-1/2 and above	6

B. Temperature range 211 to 250 degrees F:

1. Application: Steam service 15 psig and below, trap assembly discharge piping, boiler feedwater from feedwater heater to boiler feed pump recirculation, feedwater heater overflow, heated oil from oil heater to burners.
2. Insulation and Jacket:
  - a. Calcium silicate for piping from zero to 0 to 6 feet above boiler room floor, feedwater heater mezzanine floor and access platform, and any floors or access platforms on which tanks or pumps are located.
  - b. Mineral Fiber or rigid closed cell phenolic foam for remaining locations.
  - c. ASJ with PVC premolded fitting coverings.
  - d. Aluminum jacket from zero to 6 feet) above floor on condensate lines at boilers and burners.
3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness of Insulation	
Pipe Diameter (in)	Insulation Thickness (in)
1 and below	2
1-1/4 to 1-1/2	2
1-1/2 and above	3

4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness of Insulation	
Pipe Diameter (in)	Insulation Thickness (in)
1 and below	1.5
25 to 38 (1-1/4 to 1-1/2)	1.5
38 (1-1/2) and above	3

C. Temperature range 90 to 211 degrees F:

1. Application: Pumped condensate, vacuum heating return, gravity and pumped heating returns, condensate transfer, condensate transfer pump recirculation, heated oil system to heaters and returns from burners, condensate return from convertors and heated water storage tanks.
2. Insulation Jacket:
  - a. Calcium silicate for piping from zero to six feet above boiler room floor, feedwater heater mezzanine floor and access platform and any floor or access platform on which tanks or pumps are located.
  - b. Mineral fiber or rigid closed-cell phenolic foam for remaining locations.
  - c. ASJ with PVC premolded fitting coverings.



3. Thickness-calcium silicate and mineral fiber insulation:

Nominal Thickness of Insulation	
Pipe Diameter (in)	Insulation Thickness (in)
1 and below	1.5
1-1/4 to 1-1/2	2
1-1/2 and above	3

4. Thickness-rigid closed-cell phenolic foam insulation:

Nominal Thickness of Insulation	
Pipe Diameter (in)	Insulation Thickness (in)
1 and below	0.75
1-1/4 to 1-1/2	0.75
1-1/2 and above	1

D. Protective insulation to prevent personnel injury:

1. Application: Piping from zero to 6 feet above all floors and access platforms including continuous blowoff, feedwater and boiler water sample, blowoff tank vent, flash tank vents and condensater tank vent, shot-type chemical feed, fire tube boiler bottom blowoff after valves, valve by-passes.
2. Insulation thickness: 1 inch.
3. Insulation and jacket: Calcium silicate with ASJ except provide aluminum jacket on piping at boilers within 6 feet of floor. Use PVC premolded fitting coverings when all service jacket is utilized.

E. Installation:

1. At pipe supports, weld pipe covering protection saddles to pipe, except where MS-SP58, type 3 pipe clamps are utilized.
2. Insulation shall be firmly applied, joints butted tightly, mechanically fastened by stainless steel wires on 12 inch centers.
3. At support points, fill and thoroughly pack space between pipe covering protective saddle bearing area.
4. Terminate insulation and jacket hard and tight at anchor points.
5. Terminate insulation at piping facilities not insulated with a 45 degree chamfered section of insulating and finishing cement covered with jacket.
6. On calcium silicate, mineral fiber and rigid closed-cell phenolic foam systems, insulated flanged fittings, strainers and valves with sections of pipe insulation cut, fitted and arranged neatly and firmly wired in place. Fill all cracks, voids and coat outer surface with insulating cement. Install jacket. Provide similar construction on welded and threaded fittings on calcium silicate systems or use premolded fitting insulation.
7. On mineral fiber systems, insulate welded and threaded fittings more than 2 inches in diameter with compressed blanket insulation (minimum 2/1) and finish with jacket or PVC cover.
8. Insulate fittings 2 inches and smaller with mastic finishing material and cover with jacket.
9. Insulate valve bonnet up to valve side of bonnet flange to permit bonnet flange removal without disturbing insulation.



10. Install jacket smooth, tight and neatly finish all edges. Over wrap ASJ butt strips by 50 percent. Secure aluminum jacket with stainless steel bands 12 inches on center or aluminum screws on 4 inch centers.
11. Do not insulate basket removal flanges on strainers.

### 3.8 PIPE INSULATION SCHEDULE

A. Provide insulation for piping systems as scheduled below:

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 (R, HWS, HWR)	Mineral Fiber (Above ground piping only)	1.5	1.5	2.0	2.0

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.
  - 2. Extension of domestic water make-up 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, Convection Heating and Cooling Units.

##### 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, Grooved 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 Type L (aboveground), hard drawn.
  - B. Cooling Coil Condensate Drain Piping:
    - 1. From air handling units: Copper water tube, ASTM B88, Type M, or schedule 40 PVC plastic piping.
    - 2. From fan coil or other terminal units: Copper water tube, ASTM B88, Type L for runouts and Type M for mains.
  - 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: Convolute, 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 B.
  
- 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, grooved, 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 PRESSURE/TEMPERATURE TEST PROVISIONS

- A. Pete's Plug: 1/4 inch MPT by 3 inches long, brass body and cap, with retained safety cap, nordel self-closing valve cores, permanently installed in piping where shown, or in lieu of pressure gage test connections shown on the drawings.



## 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. Soldered 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 21 23

### HYDRONIC PUMPS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

- A. Hydronic pumps for Hydronic Heating System.

##### 1.2 RELATED WORK

- A. Section 23 05 11, Common Work Results For HVAC.
- B. Section 23 21 13, Hydronic Piping.

##### 1.3 QUALITY ASSURANCE

- A. Design Criteria:
  - 1. Pump sizes, capacities, pressures, operating characteristics, and efficiency shall be as scheduled.
- B. 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. Pumps and accessories including pump curves.
- 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 Iron and Steel Institute (AISI):
  - AISI 1045.....Cold Drawn Carbon Steel Bar, Type 1045
  - AISI 416.....Type 416 Stainless Steel
- C. American National Standards Institute (ANSI):
  - ANSI B15.1-00(R2008)..... Safety Standard for Mechanical Power Transmission Apparatus



ANSI B16.1-05 .....Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125,  
250 and 800

- D. American Society for Testing and Materials (ASTM):  
A48-03 (2008).....Standard Specification for Gray Iron Castings  
B62-2009.....Standard Specification for Composition Bronze or Ounce  
Metal Castings

## 1.6 DEFINITIONS

- A. Capacity: Gallons per minute (GPM) of the fluid pumped.  
B. Head: Total dynamic head in (feet) of the fluid pumped.

## PART 2 - PRODUCTS

### 2.1 PUMPS

- A. As Scheduled on Drawings.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

- A. Follow manufacturer's written instructions for pump mounting and start-up.  
Access/Service space around pumps shall not be less than minimum space  
recommended by pumps manufacturer.  
B. Coordinate location of thermometer and pressure gauges as per Section 23 21 13,  
Hydronic Piping.

### 3.2 START-UP

- A. Verify that the piping system has been flushed, cleaned, and filled.  
B. Prime the pump, vent all air from the casing and verify that the rotation is correct. To  
avoid damage to mechanical seals, never start or run the pump in dry condition.

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.
- B. Section 23 07 11, HVAC Insulation: Requirements for piping insulation.

##### 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: For piping up to 4 inch use Copper refrigerant tube, ASTM B280, cleaned, dehydrated and sealed, marked ACR on hard temper straight lengths. Coils shall be tagged ASTM B280 by the manufacturer.

### 2.2 GAGES

- A. Temperature Gages: Comply with ASME B40.200. Industrial-duty type and in required temperature range for service in which installed. Gages shall have Fahrenheit scale in 2-degree)graduations and with black number on a white face. The pointer shall be adjustable. Rigid stem type temperature gages shall be provided in thermal wells located within 5 feet of the finished floor. Universal adjustable angle type or remote element type



temperature gages shall be provided in thermal wells located 5 to 7 feet above the finished floor. Remote element type temperature gages shall be provided in thermal wells located 7 feet above the finished floor.

## 2.3 PIPE SUPPORTS

A. Refer to specification Section 23 05 11, Common Work Results for HVAC.

## 2.4 PIPE/CONDUIT ROOF PENETRATION COVER

A. Flashing Sleeves: Provide sheet metal sleeves for conduit and pipe penetrations of the penetration cover. Seal watertight penetrations.

# 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. 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.
4. Use copper tubing in protective conduit when installed below ground.
5. Install hangers and supports per ASME B31.5 and the refrigerant piping manufacturer's recommendations.

B. Joint Construction:

1. Brazed Joints: Comply with AWS "Brazing Handbook" and with filler materials complying with AWS A5.8/A5.8M.
  - a. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper tubing.
  - b. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.
  - c. Swab fittings and valves with manufacturer's recommended cleaning fluid to remove oil and other compounds prior to installation.
  - d. Pass nitrogen gas through the pipe or tubing to prevent oxidation as each joint is brazed. Cap the system with a reusable plug after each brazing operation to retain the nitrogen and prevent entrance of air and moisture.



- 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 05 11, Common Work Results For HVAC.
- B. Apply two coats of weather-resistant finish as recommended by the manufacturer to insulation exposed to outdoor weather.

### 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.
- B. Systems containing more than 110 lb of refrigerant shall be provided with durable signs, in accordance with ANSI A13.1 and ANSI Z535.1, having letters not less than 13 mm 1/2 inch in height designating:
  - 1. Valves and switches for controlling refrigerant flow, the ventilation and the refrigerant compressor(s).
  - 2. Signs on all exposed high pressure and low-pressure piping installed outside the machinery room, with name of the refrigerant and the letters "HP" or "LP."

### 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 or as follows:
  1. Connect a drum of refrigerant to charging connection and introduce enough refrigerant into system to raise the pressure to 10 psi gage. Close valves and disconnect refrigerant drum. Test system for leaks with halide test torch or other approved method suitable for the test gas used. Repair all leaking joints and retest.
  2. Connect a drum of dry nitrogen to charging valve and bring test pressure to design pressure for low side and for high side. Test entire system again for leaks.
  3. Evacuate the entire refrigerant system by the triplicate evacuation method with a vacuum pump equipped with an electronic gage reading in microns. Pull the system down to 500 microns 2245.6 inches of mercury at 60 degrees F and hold for four hours then break the vacuum with dry nitrogen (or refrigerant). Repeat the evacuation two more times breaking the third vacuum with the refrigeration to be charged and charge with the proper volume of refrigerant.

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. Supply air, return air, outside air, exhaust, make-up air, and relief systems.
- 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.
- C. Air Terminal Units: Section 23 36 00, Air Terminal Units.
- E. Testing and Balancing of Air Flows: Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.
- F. Smoke Detectors: Division 28.

##### 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. Fire dampers, fire doors, and smoke dampers with installation instructions.
3. Flexible ducts and clamps, with manufacturer's installation instructions.
4. Flexible connections.
5. Instrument test fittings.

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. Specified Corrosion Resistant Systems: Stainless steel sheet, ASTM A167, Class 302 or 304, Condition A (annealed) Finish No. 4 for exposed ducts and Finish No. 2B for concealed duct or ducts located in mechanical rooms.
- C. Grease Duct Materials:
  - 1. Grease Duct: Double wall factory-built grease duct, UL labeled and complying with NFPA 96 may be furnished in lieu of specified materials for kitchen and grill hood exhaust duct. Installation and accessories shall comply with the manufacturers catalog data. Outer jacket of exposed ductwork shall be stainless steel. Square and rectangular duct shown on the drawings will have to be converted to equivalent round size.
- D. 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.
- E. 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. stainless steel made liquid tight with continuous external weld for all seams and joints. Provide neoprene gaskets at flanged connections. Where ducts are not self draining back to the equipment, provide low point drain pocket with copper drainpipe to sanitary sewer. Provide access door inside of duct at drain pockets.
- D. 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.
- E. 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. Each fire damper (for link service), smoke damper and automatic control damper.
  - 2. Each duct mounted smoke detector.
- 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 FIRE DAMPERS

- A. Galvanized steel, interlocking blade type, UL listing and label, 1-1/2 hour rating, 160 degrees F fusible line, 100 percent free opening with no part of the blade stack or damper frame in the air stream.
- B. Fire dampers in wet air exhaust shall be of stainless steel construction, all others may be galvanized steel.
- C. Minimum requirements for fire dampers:
  - 1. The damper frame may be of design and length as to function as the mounting sleeve, thus eliminating the need for a separate sleeve, as allowed by UL 555. Otherwise provide sleeves and mounting angles, minimum 14 gage, required to provide installation equivalent to the damper manufacturer's UL test installation.
  - 2. Submit manufacturer's installation instructions conforming to UL rating test.

### 2.5 SMOKE DAMPERS



- A. Maximum air velocity, through free area of open damper, and pressure loss: Low pressure and medium pressure duct (supply, return, exhaust, outside air): 1,500 fpm. Maximum static pressure loss: 0.13 inch W.G.
- B. Maximum air leakage closed damper: at 3 inch W.G. differential pressure.
- C. Minimum requirements for dampers:
  - 1. Shall comply with requirements of Table 6-1 of UL 555S, except for the Fire Endurance and Hose Stream Test.
  - 2. Frame: Galvanized steel channel with side, top and bottom stops or seals.
  - 3. Blades: Galvanized steel, parallel type preferably, 12 inch maximum width, edges sealed with neoprene, rubber or felt, if required to meet minimum leakage. Airfoil (streamlined) type for minimum noise generation and pressure drop are preferred for duct mounted dampers.
  - 4. Shafts: Galvanized steel.
  - 5. Bearings: Nylon, bronze sleeve or ball type.
  - 6. Hardware: Zinc plated.
  - 7. Operation: Automatic open/close. No smoke damper that requires manual reset or link replacement after actuation is acceptable. See drawings for required control operation.
- D. Motor operator (actuator): Provide electric as required by the automatic control system, externally mounted on stand-offs to allow complete insulation coverage.

## 2.6 COMBINATION FIRE AND SMOKE DAMPERS

- A. Combination fire and smoke dampers: Multi-blade type units meeting all requirements of both fire dampers and smoke dampers shall be used where shown and may be used at the Contractor's option where applicable.

## 2.7 FIRE DOORS

- A. Galvanized steel, interlocking blade type, UL listing and label, 160 degrees F fusible link, 3 hour rating and approved for openings in Class A fire walls with rating up to 4 hours, 100 percent free opening with no part of the blade stack or damper frame in the air stream.

## 2.8 FLEXIBLE AIR DUCT

- A. General: Factory fabricated, complying with NFPA 90A for connectors not passing through floors of buildings. Flexible ducts shall not penetrate any fire or smoke barrier which is required to have a fire resistance rating of one hour or more. Flexible duct length shall not exceed 5 feet. Provide insulated acoustical air duct connectors in supply air duct systems and elsewhere as shown.
- B. Flexible ducts shall be listed by Underwriters Laboratories, Inc., complying with UL 181. Ducts larger than 8 inches in diameter shall be Class 1. Ducts 8 inches in diameter and smaller may be Class 1 or Class 2.



- C. Insulated Flexible Air Duct: Factory made including mineral fiber insulation with maximum C factor of 0.25 at 75 degrees F mean temperature, encased with a low permeability moisture barrier outer jacket, having a puncture resistance of not less than 50 Beach Units. Acoustic insertion loss shall not be less than 3 dB per foot of straight duct, at 500 Hz, based on 6 inch duct, of 2,500 fpm.
- D. Application Criteria:
  - 1. Temperature range: 0 to 200 degrees F internal.
  - 2. Maximum working velocity: 4,000 feet per minute.
  - 3. Minimum working pressure, inches of water gage: 10 inches positive, 2 inches negative.
- E. Duct Clamps: 100 percent nylon strap, 175 pounds minimum loop tensile strength manufactured for this purpose or stainless steel strap with cadmium plated worm gear tightening device. Apply clamps with sealant and as approved for UL 181, Class 1 installation.

## 2.9 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. Install fire dampers, smoke dampers and combination fire/smoke dampers in accordance with the manufacturer's instructions to conform to the installation used for the rating test. Install fire dampers, smoke dampers and combination fire/smoke dampers at locations required by Code. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges per UL and NFPA. Demonstrate re-setting of fire dampers and operation of smoke dampers to the Owner.
- E. Seal openings around duct penetrations of floors and fire rated partitions with fire stop material as required by NFPA 90A.
- F. Flexible duct installation: Refer to SMACNA Standards, Chapter 3. Ducts shall be continuous, single pieces not over 5 feet long (NFPA 90A), as straight and short as feasible, adequately supported. Centerline radius of bends shall be not less than two duct diameters. Make connections with clamps as recommended by SMACNA. Clamp per SMACNA with one clamp on the core duct and one on the insulation jacket. Flexible ducts shall not penetrate floors, or any chase or partition designated as a fire or smoke barrier, including corridor partitions fire rated one hour or two hour. Support ducts SMACNA Standards.
- G. Exposed ductwork in Main Dining and Bar Areas shall painted black.
- H. 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. Assemble multiple sections dampers with required interconnecting linkage and extend required number of shafts through duct for external mounting of damper motors.
  3. Provide necessary sheet metal baffle plates to eliminate stratification and provide air volumes specified. Locate baffles by experimentation, and affix and seal permanently in place, only after stratification problem has been eliminated.
  4. Install all damper control/adjustment devices on stand-offs to allow complete coverage of insulation.



- I. 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.

### 3.2 DUCT LEAKAGE TESTS AND REPAIR

- A. Ductwork leakage testing shall be performed by the Testing and Balancing Contractor directly contracted by the General Contractor and independent of the Sheet Metal Contractor.
- B. Ductwork leakage testing shall be performed for the entire air distribution system (including all supply, return, exhaust and relief ductwork), section by section, including fans, coils and filter sections.
- C. Test procedure, apparatus and report shall conform to SMACNA Leakage Test manual. The maximum leakage rate allowed is 4 percent of the design air flow rate.
- D. All ductwork shall be leak tested first before enclosed in a shaft or covered in other inaccessible areas.
- E. If any portion of the duct system tested fails to meet the permissible leakage level, the Contractor shall rectify sealing of ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated to the Engineer.
- F. All tests and necessary repairs shall be completed prior to insulation or concealment of ductwork.
- G. Make sure all openings used for testing flow and temperatures by TAB Contractor are sealed properly.

### 3.3 DUCTWORK EXPOSED TO WIND VELOCITY

- A. Provide additional support and bracing to all exposed ductwork installed on the roof or outside the building to withstand wind velocity of 90 mph.

### 3.4 TESTING, ADJUSTING AND BALANCING (TAB)

- A. Refer to Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

END OF SECTION



## SECTION 23 33 00

### AIR DUCT ACCESSORIES

#### PART 1 - GENERAL

##### 1.1 SECTION INCLUDES

- A. Dampers:
  - 1. Fire Dampers.
  - 2. Smoke Dampers.
  - 3. Volume Control Dampers.
- B. Plenums.
- C. Drip Pans.
- D. Duct Access Doors.
- E. Duct Sleeves, Prepared Openings and Closure Collars.
- F. Duct Test Holes.
- G. Flexible Duct Connections.
- H. Round Duct Branch Taps.
- I. Turning Vanes.
- J. Wire Mesh for Screens.

##### 1.2 SUBMITTALS

- A. Submit under provisions of Division 01 Section "Submittal Procedures."
- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.



### 1.3 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Division 01 Section “Closeout Procedures.”
- B. Record actual locations of access doors and test holes.

### 1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 3 years’ experience.

### 1.5 REGULATORY REQUIREMENTS

- A. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories Inc., as suitable for the purpose specified and indicated.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Division 01 Section “Product Requirements.”
- B. Protect dampers from damage to operating linkages and blades.

## PART 2 - PRODUCTS

### 2.1 GALVANIZED STEEL

- A. Steel sheet metal components of accessories in this Specification Section shall be galvanized steel sheet, lock-forming quality, having G90 or heavier zinc coating conforming to ASTM A653 rating system and tested in accordance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts, where available.

### 2.2 DAMPERS

- A. Manufacturers:
  1. Ruskin.
  2. Air Balance, Inc.
  3. Arrow.
  4. Cesco.
  5. Greenheck.
  6. NCA.
  7. Tamco.
  8. Ventex.
  9. Vent Products, Inc.
  10. No substitutions.





B. Fire Dampers:

1. Fabricate in accordance with NFPA 90A and UL 555, and as specified or as indicated on the Drawings.
2. Fire Dampers Other Than Ceiling Dampers:
  - a. For systems in which the fan stops immediately and automatically in any fire or smoke alarm condition:
    - 1) Static Fire Dampers: Curtain type dampers, Type B with blades out of the air stream. Galvanized steel with interlocking blades. Provide stainless steel closure springs for horizontal (floor) applications.
  - b. For systems in which the fan does not stop immediately in a fire or smoke alarm condition, requiring the damper to close against airflow, dynamic-closure type dampers are required by NFPA 90A:
    - 1) Fire dampers shall be of the dynamic closure type, shall have been successfully tested to UL Standard 555 - 6th Edition as to their ability to close under dynamic airflow conditions and shall bear the UL label stating that they are suitable for that application. Static fire dampers designed to operate with no airflow in the ductwork shall not be acceptable. Dynamic closure fire dampers shall have been successfully tested in both horizontal and vertical mounting positions to close against a velocity of 2,400 fpm and a static pressures of 4.5 in. w.g.
    - 2) Multiple Blade Dampers: Galvanized steel frame and blades, oil-impregnated bronze or stainless steel sleeve bearings and plated steel axles, plated steel concealed linkage, stainless steel closure spring, and blade stops. Dampers shall be dual-directional airflow rated for ease of installation.
      - a) For applications requiring a 1-1/2-hour rated damper, at operating velocities up to 1,500 fpm and fan or air handler external static pressures up to 2 in. w.g., fire dampers shall be equal to Ruskin DFD35, with vee-groove reinforced formed blades, rated for 2,000 fpm and 4 in. w.g. maximum. Pressure drop at 1,000 fpm in a 24 in. x 24 in. damper shall not exceed 0.07 in. w.g.
      - b) For applications where required fire rating, velocity, or static pressure is higher (and at lower-rated locations at the Contractor's option), dampers shall be equal to Ruskin DFD60, airfoil-shaped blades, rated for 4,000 fpm and 8 in. w.g. maximum, 1-1/2- hour or 3-hour rated as required. Pressure drop at 1,000 fpm in a 24 in. x 24 in. damper shall not exceed 0.03 in. w.g.
      - c) Damper linkage shall be capable of being held open with a pair of hand pliers while the fusible link is replaced during testing.
    - 3) Curtain-Type Dampers: For use in easy-access locations directly behind grilles and registers or open-ended ducts ONLY. Type B with blades out of the air stream. Provide thinline type where required. Galvanized steel with interlocking blades. Stainless steel closure springs.
  - c. Submittals shall include a schedule of damper locations indicating size, design airflow, design airflow face velocity, system external static pressure, and fire rating of the building assembly, with selected damper model, accompanied by damper and accessory data sheets and manufacturer's installation instructions. If only one model of damper is required, submittals may be simplified



accordingly.

- d. Dampers may be furnished with factory sleeves (verify length and gage), retaining angles, and breakaway connections at the Contractor's option.
  - e. Dampers for Out-of-Wall or Out-of-Floor Installation: Provide factory assembly including damper, sleeve, and factory-installed fire-retardant insulation.
3. Ceiling Dampers:
- a. To provide fire and heat protection where HVAC components penetrate the ceiling membrane of fire-rated floor/ceiling or roof/ceiling assemblies, standard 1-1/2 and 3 hour primary fire dampers DO NOT provide the necessary protection. Ceiling dampers are required.
  - b. Description: UL Classified radiation dampers, galvanized steel, with butterfly-type blades, UL-classified blade insulation as required.
  - c. Provide external thermal insulating blankets as required by damper manufacturer. Provide retainer wire as required.
  - d. Associated components (air devices, ductwork, supports) shall be steel. For installation with non-ferrous air devices, provide steel extensions and/or steel angles to the ceiling surface as required by damper manufacturer.
4. Fusible Links: UL 33, separate at 165 degrees F with adjustable link straps for combination fire/balancing dampers. Provide links melting at 212 degrees F within 50 feet downstream of heating coils.
- a. Mounting shall either be the flat-strap type requiring no tools to bend the straps for removing the link, or shall use standard threaded hex-nut fastening. Fastening with heavy-gauge wire hooks or other methods requiring difficult bending are not allowed.
  - b. Links shall be Nailor Industries Easy Maintenance Link (EML) or equal. Accessible from either side of the damper. Allows for releasing, testing, and relatching of blades with one hand.
5. Testing and Access: See Part 3 of this Section for requirements for field testing of each damper, and associated access doors. Provide replacement fusible links as required. During testing, furnish means for holding dampers open while fusible link is reset.

C. Smoke Dampers:

1. Dampers shall be equal to Ruskin SD60 (galvanized steel) or SD50 (aluminum) with airfoil blades.
2. Fabricate in accordance with NFPA 90A and UL 555S - 4th Edition, and as specified or as indicated on the Drawings. Rated operation shall be 4,000 fpm face velocity and 8 in. w.g. static pressure. Sizes with these ratings are limited; provide multiple sections where necessary.
3. Dampers: UL Leakage Class 1 multiple blade type smoke damper, normally open or closed (verify application), automatically operated by electric actuator.



4. Operators: UL listed and labeled direct-coupled spring-return electric type suitable for 120 volts, single phase, 60 Hz.
  - a. At Contractor's option, actuator voltage may be 24 VAC; provide power supplies as required.
  - b. Provide end switches to indicate damper position.
  - c. Locate damper operator on exterior of duct and link to damper operating shaft.

D. Volume Control Dampers:

1. Exhaust Ducts Serving Fume Hoods:
  - a. Greenheck HCDR-250, suitable for fume hood exhaust. Type 316 stainless steel construction of frame, blade, and axle. Flanged channel or other style frame suitable for welding to the duct. No blade seals. Pin or bar blade stop. Outboard-mounted bronze sleeve axle bearings. Viton o-ring axle seals.
  - b. Fabricate to comply with SMACNA Round Industrial Duct Construction Standards.
2. Other Ducts:
3. Factory-fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.
4. Shop fabrication is permitted for single blade dampers only.
5. Height is the dimension perpendicular to the blade rod or shaft. Width is the dimension parallel to the blade rod.
6. Single Blade Dampers: For duct sizes (height x width) up to 7 x 30 inch. When height or width exceeds its respective maximum, provide multi-blade damper.
7. Multi-Blade Damper: Opposed blade pattern with maximum blade sizes (height x width) 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
8. End Bearings: Except in round ductwork 6 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon or sintered bronze bearings. Provide retainer clips or other devices to prevent bearings from pulling out. For single-blade dampers, plastic bearings are allowed.
  - a. Manufacturers:
    - 1) Duro Dyne.
    - 2) Elgen Manufacturing.
    - 3) Rossi.
    - 4) Ventfabrics.
  - b. Snap-in Plastic Bearings for Single-Blade Dampers: Designed to push into hole in sheet metal, with retaining tabs. Flame Retardant, Glass Reinforced, "Zytel" polymer by Dupont, conforming to UL 1995 and UL 94 with the required flammability rating of 5VA or lower. Acceptable materials include Polyamide 66 (PA66) (glass-reinforced Dupont Zytel), nylon and acetyl. Submit manufacturer's verification of the suitability of these bearings for the application, including operating pressures and temperatures.



9. Quadrants:
  - a. Manufacturers:
    - 1) Duro-Dyne.
    - 2) Elgen Manufacturing.
    - 3) Ventfabrics.
  - b. Duro-Dyne Specline SR and SRH series; Quadline series; or Stampline dial regulators and wedge-loc regulators. Or equal by Elgen, or Ventfabrics. Factory- manufactured dampers shall have damper manufacturer's choice of quadrant equal to the Duro-Dyne products specified.
  - c. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Regulators shall include lever handle, locking wing nut and graduated indicator dial. Provide shaft seals, bushings, or gaskets for duct penetrations. Quadrants without these features are not allowed.
  - d. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters, with open space to run insulation through.
  - e. Where rod lengths exceed 30 inches provide regulator at both ends, with a single rod so that either regulator will control the entire damper.
10. Provide required operating wrenches for balancing, and furnish to the Owner at project completion.

### 2.3 IRIS DAMPERS

- A. Manufacturers:
  1. Ruskin - VFBD35 Series.
  2. Continental Fan Manufacturing Inc. – Iris Series.
  3. FanTech - IR Series.
- B. Galvanized steel construction, full circumferential neoprene or EPDM seals to inlet and outlet ducts, 6 CFM maximum casing leakage, permanent plastic or metal pressure taps, accuracy +/-5 percent. Frame shall fully encapsulate iris blade segments, and have rolled edges for strength. Blade segments shall be internally linked to an adjustment knob or lever with calibrated position indicator. Internal linkage fully encapsulated out of the airstream. Linear response of airflow to damper position. Designed for low self-noise generation.
- C. Blades open fully for duct cleaning. Full airtight closure capability is not required unless indicated on the Drawings.
- D. Installation Note: For precise metering of airflow, the iris damper should be located at minimum 1 diameter before or after an elbow, 3 diameters before a tee, 1 diameter after a tee, and 3 diameters before an outlet register.



## 2.4 DUCT ACCESS DOORS

### A. Manufacturers:

1. Standard Doors:
  - a. Ruskin.
  - b. Air Balance, Inc.
  - c. Arrow.
  - d. Buckley Associates.
  - e. Cesco.
  - f. DuctMate.
  - g. Greenheck.
  - h. Nailor.
  - i. Vent Products, Inc.
  - j. Shop fabricated.
2. Medium and High-Pressure Doors:
  - a. Ruskin.
  - b. DuctMate.
  - c. Greenheck.
  - d. Nailor.
  - e. No substitutions.
3. Grease Duct Doors:
  - a. Ductmate.
  - b. Shop fabricated.

B. Fabricated in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings. Standard access doors and access doors for grease ducts may be shop-fabricated. Pressure rating shall be equal to the rating of the associated ductwork; see Part 3 Division 23 Section "HVAC Ducts" for schedule of pressure classes.

C. Standard Doors: Removable, with retainer chain. Rigid and close-fitting with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum 1 inch thick insulation with galvanized steel sheet metal airstream-side cover.

1. 16 inches Square and Smaller: Secure with two sash locks.
2. Over 16 inches, up to 24 inches. Square: Provide four sash locks.
3. Larger Sizes: Hinges and two compression latches with outside and inside handles.
4. Clamping-type doors with knob handles, as manufactured by Ductmate, may be substituted for standard sizes.
5. Material: Galvanized steel in galvanized steel ductwork. Stainless steel in stainless steel ductwork. Aluminum as manufactured by Arrow in aluminum ductwork.
6. Provide in negative-pressure systems, and in positive-pressure systems with specified pressure class at or below 2 in. WG.

### D. Access Doors For Grease Duct Applications:

1. Shop-fabricated:
  - a. Material to match duct.
  - b. High-temperature ceramic gasket, suitable for at least 1500 degrees F.



2. Ductmate Industries, Inc. HI-TEMP access door, or approved equal.
  - a. 16 gage black iron backing plate.
  - b. High temperature ceramic gasket, 2300 degrees F maximum.
  - c. Zinc plated conical springs, zinc coated wing nuts and zinc plated carriage bolts.
3. Ductmate Industries, Inc. ULtimate or ULtimate II access door.
  - a. UL 1978 Listed.
  - b. UL label and “Do Not Obstruct” label.
  - c. 2 layers of 11 gage metal (provide black iron (carbon steel) or Type 304 stainless to match ductwork).
  - d. High temperature ceramic gasket, 2300 degrees maximum.
  - e. The ULtimate door is sandwich style, and requires no welding and special tools, but requires extra duct size.
  - f. The ULtimate II door has a welded frame, and is available with or without a piano hinge.
  - g. Collapsible loop handle welded to outer door.
  - h. Corner thumb bolts. ULtimate door has studs with wingnuts welded to inner door.
  - i. Can be used with high temperature insulation.
4. For factory-manufactured round grease ducts, access doors may be furnished by the duct manufacturer. For double-wall ducts, access doors shall include inner and outer stainless steel and inner layer of insulation.
5. Duct openings in horizontal ducts shall be above the bottom of duct to form a grease dam.
6. Meet NFPA 96 requirements for use in grease duct systems.

E. Access doors with sheet metal screw fasteners are not acceptable.

F. Sizing: Select sizes to allow testing, service, and maintenance within the ductwork. Such access may require the insertion of one or both hands, arms, and shoulders as appropriate. Doors sized for viewing-only are not acceptable. Doors found to be of inadequate size shall be replaced with proper size.

## 2.5 DUCT SLEEVES, PREPARED OPENINGS AND CLOSURE COLLARS

A. Duct Sleeves and Closure Collars: Fabricate from minimum 20 ga galvanized steel or equivalent thickness of aluminum, select material to match duct material. Where sleeves are installed in bearing walls, provide structural steel sleeves.

B. Prepared Openings: Provide 1 inch clearance between the duct and the sleeve.

## 2.6 DUCT TEST HOLES

A. Manufacturers:

1. Ductmate.
2. Carlyle Corporation.
3. Duro-Dyne.
4. Ventfabrics.



- B. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- C. Permanent Test Holes: Factory fabricated, airtight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

## 2.7 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
  - 1. Ductmate.
  - 2. Ventfabrics.
  - 3. Duro-Dyne.
  - 4. No substitutions.
- B. Fabricate in accordance with SMACNA HVACDCS, and as specified or as indicated on the Drawings.
- C. Connector: Fabric crimped into metal edging strip.
  - 1. Connectors shall be Ductmate PROFLEX Commercial series.
  - 2. Fabric: UL listed coated woven glass fiber fabric meeting the requirements of NFPA 90A and NFPA 701. Resistant to weather and most chemicals, fat, grease, and oil.
    - a. Supply Ducts: Neoprene coated, minimum density 30 oz per sq yd. Fire-retardant coating. Black color. Temperature range -40 to 200 degrees F.
    - b. Exhaust Ducts Serving Fume Hoods: Hypalon coated, minimum density 24 oz per sq yd. Flame proof coating. White color. UV and ozone resistant. Temperature range -40 to 250 degrees F.
  - 3. Net Fabric Width: Approximately 3 inches wide.
  - 4. Metal: 3 inch wide, 24 ga.
    - a. Supply Ducts: G-60 galvanized steel.
    - b. Exhaust Ducts Serving Fume Hoods: Type 316 stainless steel.
  - 5. Connectors shall have double fold seams. Single fold seams (metal folded once only) shall not be accepted.

## 2.8 ROUND DUCT BRANCH TAPS AND SPIN-IN FITTINGS

- A. Saddle Taps: For round ducts branching off main ducts at 90 degrees, provide factory fabricated, saddle-tap fittings with conical or bellmouth taps, or 45 degree rectangular-to-round branch fittings. For round ducts branching off at 45 degrees, fittings do not require conical or bellmouth expansion. Fittings shall be furnished with flange for fastening and sealing designed to overlap onto adjacent duct, and shall be shaped to fit tight to the exterior of the duct, flat for rectangular duct, curved for round duct.
- B. Spin-in fittings, factory-fabricated with conical or bellmouth taps are an acceptable substitute for saddle taps.



- C. Factory-fabricated taps and spin-ins may be furnished with integral volume dampers and quadrants as specified in paragraph “Manual Dampers” in this Section.

## 2.9 TURNING VANES

- A. Manufacturers for Turning Vanes and Vane Rails:
  - 1. Ductmate Industries - PROrail 2 inch Turning Vane Rail.
  - 1. Duro Dyne - Junior Vane Rail.
  - 2. Hardcast, a division of Carlisle Corporation - Dyn-O-Rail Jr.
- B. Factory-fabricated and factory-or-field-assembled units consisting of curved turning vanes for uniform air distribution and change of direction with minimum turbulence and pressure loss. Provide curved single thickness vanes for mitered elbows with change in direction of 45 degrees or greater, conforming to SMACNA HVACDCS single vane schedule for small vanes. Each vane shall form a 90 degree arc. Fill the entire duct cross-section with vanes. Orient leading edge of vanes parallel to the side of the duct (directed straight into the entering airstream).
- C. Turning vanes shall be minimum 16 gauge, regardless of gauges that are recommended by SMACNA. Double thickness turning vanes are not allowed.
- D. Turning vanes in rectangular ductwork and shop-fabricated round ductwork shall conform with details on the Drawings. If not detailed, the SMACNA detail for small-radius small-spacing single-thickness vanes shall be used.
- E. Turning vanes in manufactured round and flat oval duct elbows shall be the duct manufacturer’s standard size, spacing, and gauge, but must be single-wall and not less than 16 gauge.
- F. Material for vanes shall be the same as the duct sheet metal.
- G. Factory-fabricated turning vane rails shall be a minimum of 24 ga and shall be the same material as the duct sheet metal.

## 2.10 WIRE MESH FOR SCREENS

- A. Manufacturers:
  - 1. McNichols Co.
  - 2. Banker Wire and Iron Works, Inc.
  - 3. Belleville Wire Cloth Co.
  - 4. Edward J. Darby & Son, Inc.
  - 5. No substitutions.
- B. Galvanized Welded Wire Mesh: Hardware and industrial class welded wire square mesh, hot dipped galvanized, welded trimmed construction, 2 mesh (2 openings per inch, wires ½ inch on center), 0.0630 inch wire nominal diameter parallel to width and





length, 0.437 inch openings, 76 percent open area, 0.51 lb/sq. ft weight. Specification is the minimum acceptable for strength and weight of materials.

- C. Material to Match Ductwork: Where screens are installed in ductwork or louvers of other materials such as stainless steel or aluminum, provide screens of material to match the ductwork or louver, with strength equal to the requirements specified for galvanized mesh. Aluminum screens may be fabricated of expanded metal instead of welded wire.
- D. Provide mesh installed in a removable frame to support the mesh completely flat and rigid, with fasteners in an accessible location.

## 2.11 UNIFORMITY OF MATERIALS

- A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Verify that electric power is available and of the correct characteristics.

### 3.2 INSTALLATION

- A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA HVACDCS. Refer to Division 23 Section "HVAC Ducts" for duct construction and pressure class.
- B. Install components furnished under other Section and Divisions of the Specifications.
- C. Duct Hangers and Supports: SMACNA HVACDCS, Section 4.
  - 1. Flexible Ducts: Support ducts by hangers every 3 feet, unless supported by ceiling construction. Stretch flexible air ducts to smooth out corrugations, and long radius elbows, where possible, using a minimum length to make connections.
  - 2. Flexible Connectors: Provide flexible connectors between fans and ducts or casings and where ducts are of dissimilar metals. For round ducts, securely fasten flexible connectors by zinc-coated steel clinch-type draw-bands. For rectangular ducts, lock flexible connectors to metal collars.
- D. Attach supports only to structural framing members and non-metal deck concrete slabs. Do not anchor supports to metal decking unless a means is provided and approved for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing member, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.



E. Access Doors:

1. Provide duct access doors in horizontal return air, exhaust air and fresh air intake ductwork to facilitate the removal of accumulations of dust and combustible materials in accordance with NFPA 90A. Install access doors at maximum 20 foot (6 m) intervals and at the base of each vertical riser.
2. Provide duct access doors for inspection, servicing, and cleaning before filters, before and after coils, before and after fans, before automatic dampers, at fire dampers, at smoke dampers, at combination fire and smoke dampers, at smoke detector sampling tubes (upstream of the sampling tube), at multiple blade volume dampers, at backdraft and counterbalanced dampers, and elsewhere as specified or as indicated on the Drawings. Provide at changes in direction of kitchen exhaust ductwork and as otherwise required for cleaning kitchen exhaust ductwork in accordance with NFPA 96. Provide minimum 8 x 8 inch size for hand access, 18 x 18 inch size for shoulder access, and as specified or as indicated on the Drawings. Review locations prior to fabrication.
3. Access doors installed for access to fire dampers and fire/smoke dampers shall have one side at least 12 inches long to allow two hand access. Provide identification with letters of minimum 1/2 inch height to indicate the presence of fire protection devices within. Conform with NFPA 90A and applicable Codes. Refer to Division 23 Section "Identification for HVAC Piping and Equipment" for labeling materials specifications.

F. Grease Duct Access Doors:

1. Provide approved access doors at the following locations:
  - a. Changes in direction of kitchen exhaust ductwork.
  - b. Every 12 feet for non-vertical ductwork.
  - c. Where duct pass through multiple floors, provide access door at each floor.
2. Provide nameplate of suitable material on access doors stating, "ACCESS PANEL - DO NOT OBSTRUCT". Install access doors on top or sides of duct; in horizontal ducts, locate opening above the bottom of the duct to prevent formation of a grease dam.

G. Provide fire dampers at locations indicated, where ducts and outlets pass through fire rated components. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

H. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

I. Fire Damper Testing: Demonstrate operation and re-setting of each fire damper and fire/smoke damper to Owner's representative after installation and prior to building occupancy. Remove or melt the fusible link and allow the damper to close, then reopen the damper and replace the link. Repair or replace any damper which doesn't close and open properly. Coordinate with access door installation to ensure that access doors are of adequate size and location to allow required reach with 2 hands to hold the damper open while replacing the link.



- J. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.
- K. Provide balancing dampers on duct take-offs to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly. Where branch duct is completely above non-accessible wallboard ceiling and the Architect has not approved the use of access doors, duct mounted balancing dampers shall not be required.
- L. For volume dampers located above suspended ceilings and in areas that are not visible to building occupants (e.g. mechanical rooms), provide fluorescent orange colored surveyor's tape. Permanently attach tape to damper handles and run tape down to 10 in. above ceiling or 12 in. below damper handle where ceilings do not exist (e.g. mechanical rooms).
- M. Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and support by vibration isolators. Staple and seal connections airtight.
- N. Duct Sleeves and Prepared Openings: Install for ducts passing through roofs, ceilings, walls and floors. Field determine the proper size and location of sleeves and prepared openings.
  - 1. Duct Sleeves: Allow one-inch clearance between duct and sleeve or one-inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.
  - 2. Prepared Openings: Allow one-inch clearance between duct and opening or one-inch clearance between insulation and opening for insulated ducts, except at grilles, registers, and diffusers.
- O. Closure Collars:
  - 1. Provide not less than 4 inches wide on each side of walls or floors where sleeves or prepared openings are installed. Fit collars snugly around ducts. Grind smooth edges of collar to prevent tearing or puncturing insulation covering or vapor barrier.
  - 2. Where insulated ducts penetrate non-fire-rated walls, insulation shall be continuous through the closure collars and the closure collars shall be installed tight to the insulation.
  - 3. Where insulated ducts penetrate fire rated walls, insulate ducts on both sides of closure collars and seal points of contact between closure collar and insulation with vapor proof adhesive.
  - 4. Where ducts penetrate fire rated walls, provide fireproof sealant at closure collar. Refer to Division 07 Section "Penetration Firestopping" for fireproof sealant requirements.
  - 5. Secure closure collars to ducts with sheet metal screws at maximum 6 inch centers and secure closure collars to walls or floors with sheetrock screws, nails or other appropriate fastener at maximum 6 inch centers.



6. Packing: Pack with non-combustible glass fiber insulation in spaces between sleeve/opening and duct/duct insulation. Cover or seal edges of packing to contain loose fibers.
  
- P. Eliminators: Equip each cooling coil in casings having an air velocity of over 500 fpm through the net face area with moisture eliminators, unless the coil manufacturer guarantees, over the signature of a responsible company official, that no moisture will be carried beyond the drip pans under actual conditions of operation.
  
- Q. Drain (Drip) Pans, Drain Connections, and Drain Lines: Provide coils with drain and drain connections. Where coils are sectionalized, with one section above the other, provide intermediate drain pans. There shall be no entrainment of water in air stream. Drain condensate from drain pans to the nearest disposal points as specified or as indicated on the Drawings. Equip drain lines with U-traps and a seal height one-inch greater than the maximum static pressure rating of the fan system. Insure pans drain completely under operating conditions.
  
- R. Provide duct test holes where required for testing and balancing purposes.

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.

B. Testing and Balancing of Air Flows: Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

##### 1.3 SUBMITTALS

A. Manufacturer's Literature and Data:

1. Air intake/exhaust hoods.
2. Diffusers, registers, grilles and accessories.

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.

##### 1.4 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. Exhaust air grilles located in combination toilets and shower stalls shall be constructed from aluminum. 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.
    - a. Grille shall be suitable for duct or surface mounting as indicated on drawings. All necessary appurtenances shall be provided to allow for mounting.

### 2.2 LOUVERS

- A. As scheduled on drawings.

## 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.

### 3.2 TESTING, ADJUSTING AND BALANCING (TAB)

- A. Refer to Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

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.

##### A.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:
  - a. Suspended ceiling components.
  - b. 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: 13 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 point 24V control connection.
- 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. Dampers: Provide low leakage, insulated, spring return, motorized isolation dampers on both airstreams.

## 2.2 CONTROLS

- A. Refer to sequence of operations on drawings.



## 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 duct coil piping adjacent to unit to allow service and maintenance.
- B. Connect piping to units mounted on vibration isolators with flexible connectors.
- C. 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 CO<sub>2</sub> set points.
  - 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 23 72 00





## SECTION 23 81 29

### VARIABLE REFRIGERANT FLOW HVAC SYSTEMS

#### PART 1 – GENERAL

##### 2.1 SECTION INCLUDES

- A Air-source outdoor units.
- B Refrigerant piping.
- C Indoor units.

##### 2.2 REFERENCE STANDARDS

- A AHRI 210/240 - Performance Rating of Unitary Air-Conditioning and Air-Source Heat Pump Equipment 2023.
- B AHRI 1230 - Performance Rating of Variable Refrigerant Flow (VRF) Multi-Split Air-Conditioning and Heat Pump Equipment 2021.
- C ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- D ITS (DIR) - Directory of Listed Products current edition.
- E NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- F NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G UL 1995 - Heating and Cooling Equipment Current Edition, Including All Revisions.

##### 2.3 SUBMITTALS

- A See Section 01 30 00 - Administrative Requirements for submittal procedures.  
11395.013 23 81 29 – 1 Variable Refrigerant Flow HVAC Systems



- B Product Data:** Submit manufacturer's standard data sheets showing the following for each item of equipment, marked to correlate to equipment item markings indicated in Contract Documents:
1. **Outdoor Units:**
    - a. Refrigerant Type and Size of Charge.
    - b. Output and Input Cooling Capacity: Btu/h (W).
    - c. Output and Input Heating Capacity: Btu/h (W).
    - d. Operating Temperature Range, Cooling and Heating.
    - e. Fan Capacity: Flow in cfm (L/sec) with respective fan curves.
    - f. External Static Pressure (ESP): In-wc (Pa).
    - g. Sound Pressure Level: dB(A).
    - h. Electrical Data: Complete including motor size.
    - i. Maximum number of indoor units that can be served.
    - j. Maximum refrigerant piping run from outdoor unit to indoor unit(s).
    - k. Maximum height difference between outdoor unit to Indoor unit(s), both above and below.
  2. **Indoor Units:**
    - a. Output and Input Cooling Capacity: Btu/h (W).
    - b. Output and Input Heating Capacity: Btu/h (W).
    - c. Fan Capacity: Flow in cfm (L/sec) with respective fan curves.
    - d. External Static Pressure (ESP): In-wc (Pa).
    - e. Electrical Data: Complete including motor size.
    - f. Maximum Lift of Built-in Condensate Pump.
  3. **Control Panels:** Complete data of controllers, input-output points, and zones.
- C Operating and Maintenance Data:**
1. Manufacturer's complete standard instructions for each unit of equipment and control panel.
  2. Custom-prepared system operation, troubleshooting, and maintenance instructions and recommendations.
  3. Identification of replaceable parts and local source of supply.
- D Specimen Warranty:** Copy of manufacturer's warranties.
- E Project Record Documents:** Record the following:
1. As-installed routing of refrigerant piping and condensate piping.
  2. Locations of access panels.
  3. Locations of control panels.



## 2.4 QUALITY ASSURANCE

### A Manufacturer Qualifications:

1. Company that has been manufacturing variable refrigerant volume heat pump equipment for at least 5 years.

### B Installer Qualifications: Trained and approved by manufacturer of equipment.

## 2.5 DELIVERY, STORAGE AND HANDLING

### A Deliver, store, and handle equipment and refrigerant piping according to manufacturer's recommendations.

## 2.6 WARRANTY

### A See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

### B Compressors: Provide manufacturer's warranty for 6 years from date of installation.

## PART 2 – PRODUCTS

### 4.1 VARIABLE REFRIGERANT FLOW SYSTEM

#### A Minimum System Requirements:

1. System Testing, Capacity Rating, and Performance:
  - a. AHRI 1230 when cooling capacity is equal or greater than 65,000 Btu/h (19 kWh).
  - b. AHRI 210/240 when cooling capacity is below 65,000 Btu/h (19 kWh).
2. Safety Certification: Bear UL 1995 tested and ITS (DIR) listed certification label.
3. Outdoor Units: Furnish installation and surface support hardware products in accordance with ASCE 7 for seismic and wind restraint.

### 4.2 AIR-SOURCE OUTDOOR UNITS

#### A Heat Pump, Cooling or Heating Outdoor Units

- a. As Scheduled on the drawings.

#### B Refrigeration Side:

1. Factory assembled and wired with instrumentation, switches, and controller(s) to handle unit specifics with direct coordination of remote controller(s) from indoor unit(s).



2. Refrigeration Circuit: ECM driven dual scroll compressors, fans, condenser heat sink coil, expansion valves, solenoid valves, distribution headers, capillaries, filters, shutoff valves, oil separators, service ports, and refrigerant regulator.
3. Refrigerant: R-410a factory charged. Controller to alarm when charge is below capacity.
4. Variable Volume Control: Modulate compressed refrigerant capacity automatically to maintain constant suction and condensing pressures under varying refrigerant volume required to handle remote loads. Include defrost control.
5. Provide refrigerant subcooling to ensure the liquid refrigerant does not flash when supplying to use indoor units.
6. Capable of heating operation at low end of operating range as specified, without additional low ambient controls or auxiliary heat source; during heating operation, reverse cycle, oil return, or defrost is not permitted due to potential reduction in space temperature.
7. Power Failure Mode: Automatically restarts operation after power failure without loss of programmed settings.
8. Safety Devices: High pressure sensor with cut-out switch, low pressure sensor with cut-out switch, control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, overcurrent protection for the inverter and antirecycling timers.

#### 4.3 REFRIGERANT PIPING

- A Two-Pipe Run: Provide low-pressure vapor and high-pressure vapor gas pipes for each indoor unit selected for seasonal heating or cooling service.
- B Three-Pipe Run: Provide low-pressure vapor, high-pressure vapor gas, and liquid pipes for each indoor unit selected for off-season heating and cooling changeover service.
- C Refrigerant Flow Balancing: Provide refrigerant piping joints and headers specifically designed to ensure proper refrigerant balance and flow for optimum system capacity and performance; T-style joints are prohibited.

#### 4.4 INDOOR UNITS

- A Minimum Unit Requirements:
  1. DX Evaporator Coil:
    - a. Copper tubes expanded into aluminum fins to form a mechanical bond; waffle louver fin and high heat exchange, rifled bore tube design; factory tested.





- b. 2-, 3-, or 4-row cross fin design with 14 to 17 fins per inch and flare end-connections.
  - c. Provide thermistor on liquid and gas lines wired into local controller.
  - d. Refrigerant circuits factory-charged with dehydrated air for field charging.
2. Fan Section:
    - a. Variable or three-speed ECM fan with automatic airflow adjustment; external static pressure selectable during commissioning.
    - b. Thermally protected, direct-drive motor with statically and dynamically balanced fan blades.
    - c. Minimum-adjustable external static pressure 0.32 in-wc (80 Pa); provide for mounting of field-installed ducts.
  3. Local Unit Controls:
    - a. Temperature Control: Return air control using thermistor tied to computerized Proportional-Integral-Derivative (PID) control of superheat.
    - b. Temperature Zones:
      - 1) Single Indoor Unit: Set served space(s) as the local temperature zone.
      - 2) Multiple Indoor Units: For large zones, group and coordinate related indoor units with served spaces as the local temperature zone with each indoor unit as sub-zone.
  4. Return Air Filter:
    - a. Merv - 13 minimum.
  5. Condensate:
    - a. Built-in condensate drain pan with PVC drain connection for drainage.
    - b. Units With Built-In Condensate Pumps: Provide condensate safety shutoff and alarm.
    - c. Units Without Built-In Condensate Pump: Provide built-in condensate float switch and wiring connections.
  6. Cabinet Insulation: Sound absorbing foamed polystyrene and polyethylene insulation.
- B Wall Mounted, Indoor Units: As Scheduled on the drawings.**
1. DX coil, tubed drain pan, and built-in controls with thermostat remotely coordinated by outdoor air unit to maintain local air temperature setpoint.
  2. Variable or three-speed ECM cross-flow fan with automatic airflow adjustment; external static pressure selectable during commissioning.
  3. Return Air Filter:
  4. Provide exposed unit casing with removable front grille; foamed polystyrene and polyethylene sound insulation; wall mounting plate; polystyrene condensate drain pan.



5. Airflow Control: Auto-swing louver that closes automatically when unit stops; five (5) steps of discharge angle, set using remote controller; upon restart, discharge angle defaults to same angle as previous operation.
6. Sound Pressure Range: Measured at low speed at 3.3 feet (1 m) below and away from unit.
7. Condensate Drain Connection: Back, with piping concealed in wall.

## PART 3 – EXECUTION

### 6.1 INSTALLATION

- A Install in accordance with manufacturer's instructions.
- B Install refrigerant piping in accordance with equipment manufacturer's instructions.
- C Perform wiring in accordance with NFPA 70, National Electric Code (NEC).
- D Coordinate with installers of systems and equipment connecting to this system.

### 6.2 SYSTEM STARTUP

- A Prepare and start equipment and system in accordance with manufacturer's instructions and recommendations.
- B Adjust equipment for proper operation within manufacturer's published tolerances.

END OF SECTION



## SECTION 23 82 00

### CONVECTION HEATING AND COOLING UNITS

#### PART 1 - GENERAL

##### 1.1 DESCRIPTION

Panel Radiators, unit heaters, and convectors.

##### 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 21 13, Hydronic Piping: Heating hot water piping.
- C. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC: Flow rates adjusting and balancing.

##### 1.3 SUBMITTALS

- A. Manufacturer's Literature and Data:
  - 1. Panel Radiators.
  - 2. Convectors.
- 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.

##### 1.4 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. American National Standards Institute / Air Conditioning, Heating and Refrigeration Institute (ANSI/AHRI):
  - 440-08 .....Performance Rating of Room Fan CoilsNational 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 CONVECTORS

- A. As Scheduled on Drawings. Verify color with Architect.

### 2.2 PANEL RADIATORS

- A. As scheduled on Drawings.

## 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. 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.

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.
  2. PV Conductor Insulation: Comply with UL 4703.
- F. Cable: Comply with NEMA WC 70/ICEA S-95-658 for Hospital Grade, Type AC metal-clad 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: Hospital Grade Metal-clad cable, Type MC-HG.
- 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. Complete cable tray systems installation according to Section 26 05 36 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

### 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. Comply with requirements in Section 26 05 44 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

### 3.07 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 07 84 13 "Penetration Firestopping."

### 3.08 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 as required to obtain the specified ground resistance.

### 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 the 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.
- B. For indoor installations, leave 100 mm (4 inches) of each rod exposed.



- 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 0529

### 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.
- B. Materials: Comply with requirements in Section 05 5000 "Metal Fabrications" for steel shapes and plates.



## 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 "Raceways and Boxes for Electrical Systems."
- 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
  - 2. 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. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate 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.

##### 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 260511, 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 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. Firestop: Where conduits, wireways, and other electrical raceways pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases with an approved firestop material.
- C. 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.
- F. Painting:
  - 1. Paint exposed conduit in Main Dining and Bar areas.

### 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.
- D. Conduits run on roof shall be supported with integral galvanized lipped steel channel, attached to UV-inhibited polycarbonate or polypropylene blocks every 2.4 M (8 feet) with 9 mm (3/8-inch) galvanized threaded rods, square washer and locknut. Conduits shall be attached to steel channel with conduit clamps.

### 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 centerline 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.
- D. Delegated-Design Submittal: For arc-flash hazard study.

#### 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. Raceways and Cables Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."
- C. 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 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
    - c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.
- 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. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
    - e. Substations.
    - f. Emergency system boxes and enclosures.
    - g. Enclosed switches.
    - h. Enclosed circuit breakers.
    - i. Enclosed controllers.
    - j. Variable-speed controllers.
    - k. Push-button stations.
    - l. Contactors.
    - m. Remote-controlled switches, dimmer modules, and control devices.
    - n. Monitoring and control equipment.

END OF SECTION





## SECTION 26 05 73

### OVERCURRENT PROTECTIVE DEVICE COORDINATION / ARC-FLASH 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/arc-flash studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping. FOR ALL NEW AND EXISTING ELECTRICAL DISTRIBUTION SYSTEM.

##### 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, coordination study and arc-flash hazard 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.
5. Arc-flash study report; signed, dated, and sealed by a qualified professional engineer.
- D. Operation and Maintenance Data: For the overcurrent protective devices 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. 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. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Working distance.
6. Incident energy.
7. Hazard risk category.
8. Recommendations for arc-flash energy reduction.

I. 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 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 26 05 53 "Identification of Electrical Systems" Produce a (3.5-by-5-inch) thermal transfer label of high-adhesion polyester for each work location included in the analysis.

B. The label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Flash protection boundary.
4. Hazard risk category.
5. Incident energy.
6. Working distance.



7. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

## 2.04 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.
  2. 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 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Use the short-circuit study output and the field-verified settings of the overcurrent devices.
- C. Calculate maximum and minimum contributions of fault-current size.
  - 1. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume no motor load.
  - 2. The maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- D. Calculate the arc-flash protection boundary and incident energy at locations in the electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except 240-V ac and 208-V ac systems fed from transformers less than 125 kVA.
- F. Safe working distances shall be specified for calculated fault locations based on the calculated arc-flash boundary, considering incident energy of 1.2 cal/sq.cm.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
  - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g., contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash computation shall include both line and load side of a circuit breaker as follows:
  - 1. When the circuit breaker is in a separate enclosure.
  - 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.



### 3.05 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.

### 3.06 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.

### 3.07 LABELING

- A. Apply one arc-flash label for 600-V ac, 480-V ac, and applicable 208-V ac panelboards and disconnects and for each of the following locations:
  1. Low-voltage switchboard.
  2. Switchgear.
  3. Control panel.



### 3.08 APPLICATION OF WARNING LABELS

- A. Install the arc-fault warning labels under the direct supervision and control of the Arc-Flash Study Specialist.

### 3.09 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.
- 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.
    - b. Vacancy 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. Speakers.
    - d. Sprinklers.
    - e. Access panels.
    - f. Control modules.
    - g. Ceiling fans
    - h. Sound baffles and/or clouds.
- 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: Two 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 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
  2. Intermatic, Inc.
  3. Leviton Manufacturing Co., Inc.
  4. NSi Industries LLC.
  5. Tyco Electronics Corporation; a TE Connectivity Ltd. company.
- B. Description: Solid state, with SPST dry contacts rated for 1000 W incandescent or 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
  2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
  3. Time Delay: Fifteen-second minimum, to prevent false operation.
  4. Surge Protection: Metal-oxide varistor.
  5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.
  6. Failure Mode: Luminaire stays ON.

## 2.03 INDOOR OCCUPANCY AND VACANCY 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 or wireless connection to switch, and BAS and lighting control system.
  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.
    - b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
    - c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. 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.



## 2.04 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allen-Bradley/Rockwell Automation.
  - 2. ASCO Power Technologies, LP; a business of Emerson Network Power.
  - 3. Eaton Corporation.
  - 4. General Electric Company.
  - 5. Square D.
  
- B. Description: Electrically operated and electrically held, combination-type lighting contactors with non-fused disconnect, complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.
  - 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.
  
- C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.
  - 1. Monitoring: On-off status.
  - 2. Control: On-off operation.

## 2.05 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 0519 "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 0519 "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 0553 "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. 120/208 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 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-Interruption
  - 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.

### 2.2 TOGGLE SWITCHES

- A. Toggle switches shall be as specified on the drawings or approved equal.
  
- B. Verify color with Architect.

### 2.3 WALL PLATES

- A. Wall plates for switches and receptacles shall be type smooth nylon. Oversize plates are not acceptable.
  
- B. Verify color with Architect.
  
- 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 multi-gang 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.

## 2.4 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.

## 2.6 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 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 dimmers for incandescent lamps.

##### 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.
  - 3. Sound Performance Data: For air-handling fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section, "Diffusers, Registers and Grilles."



- 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. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- B. Metal Parts: Free of burrs and sharp corners and edges.
- C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.
- D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.
- E. 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.
- F. 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 EXIT SIGNS

- A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

## 2.05 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.
- 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 or 277 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.

## 2.06 FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section 26 0050, "Basic Electrical Methods" 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.

## 2.07 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.

## 2.8 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 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.
  - 10. Above suspended suspended ceiling system: Not Required.
  
- 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 0529 "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 FIRESTOPPING
- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."



### 3.05 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

- 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 061000 "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: Two 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 FIRESTOPPING

- A. Comply with requirements in Section 07 8413 "Penetration Firestopping."
- B. Comply with TIA-569-B, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

### 3.5 GROUNDING

- A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. Comply with J-STD-607-A.
- C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus



bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

- D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

### 3.6 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section 26 0553 "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 91 23 "Interior Painting" 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 cable 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.

### 3.7 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 communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm Category 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.

### 3.8 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 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
  - E. Arrange stub-ups so curved portions of bends are not visible above finished slab.



- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches 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 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.
- 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 13 "Penetration 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

**The building currently has an existing Fire Alarm System. The intent is to reuse the existing system and expand upon existing zones as indicated on the drawings.**

- A. Section Includes (**not all items listed may be required for this project**):

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. Combination Smoke/Carbon monoxide detectors.
9. 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 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.

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.

#### 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 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.

## 2.02 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.

## 2.03 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.).

## 2.04 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.

## 2.05 COMBUSTIBLE GAS DETECTOR

- A. Manufacturers: Macurco or approved equal.



## 2.06 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.

## 2.07 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.

## 2.08 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. 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.
  
- D. 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.
  
- E. 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.
  
- F. 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.
  
- G. Air-Sampling Smoke Detectors: If using multiple pipe runs, the runs shall be pneumatically balanced.
  
- H. 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.
  
- I. 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.
  
- J. 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.

- K. 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.
- L. 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 7100 "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 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION