

PROJECT MANUAL FOR:

# CHEMISTRY BUILDING

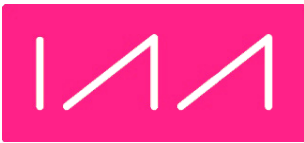
## 1ST FLOOR RENOVATION

AT UNIVERSITY OF MISSOURI – COLUMBIA

FOR THE CURATORS OF THE UNIVERSITY OF MISSOURI

**PROJECT NO. CP242331**

SEPTEMBER 26, 2024



INTERNATIONAL ARCHITECTS ATELIER



PROJECT MANUAL FOR: CHEMISTRY BUILDING – 1<sup>ST</sup> FLOOR RENOVATION

PROJECT NUMBER: CP242331

AT  
UNIVERSITY OF MISSOURI - COLUMBIA  
COLUMBIA, MISSOURI

FOR:

THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

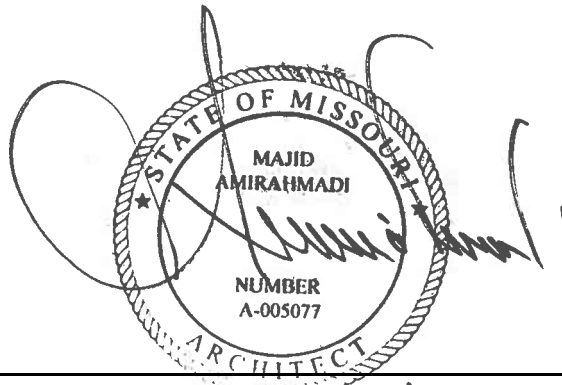
INTERNATIONAL ARCHITECTS ATELIER  
ATTN: MAJID AMIRAHMADI  
912 BROADWAY BLVD., STE. 300  
KANSAS CITY, MO 64105  
(816) 471-6522

DATE: SEPTEMBER 26, 2024

ARCHITECTURAL

The Architects seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the Architect takes responsibility for the attached architectural specifications. The Architect hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.

Specification Section 02 0810 and the Hazardous Building Material Survey are technical documents that have been prepared by a qualified third party hazardous materials testing lab. The specification was not prepared under the direct supervision of the architect and therefore is not included as part of the architect's certification.

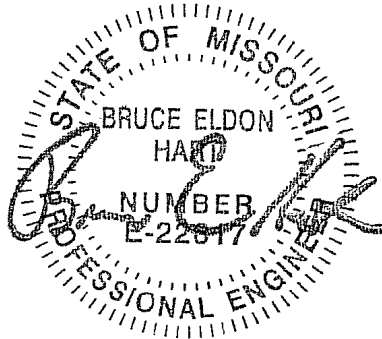


Signature: \_\_\_\_\_

09-26-2024

## MECHANICAL AND PLUMBING

The Mechanical and Plumbing Engineers seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the mechanical and plumbing engineer takes responsibility for the attached mechanical and plumbing engineering specifications. The Mechanical and Plumbing Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.



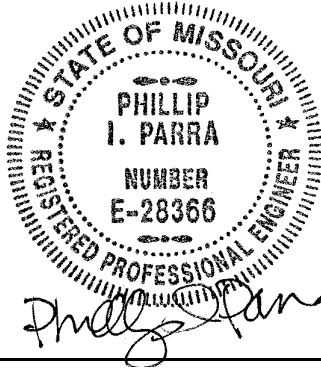
Signature: \_\_\_\_\_

**Bruce E. Hart - #E-22817**

09/26/2024

ELECTRICAL

The Electrical Engineer's seal on these contract documents has been affixed in accordance with the requirements of Chapter 327, RSMO. In affixing this seal, the electrical engineer takes responsibility for the attached electrical engineering specifications. The Electrical Engineer hereby disclaims any and all responsibility for project specifications other than these, included in these project documents, they being the responsibility of the other design professionals, whose seals and statements appear herein.



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

Phillip I. Parra - #E28366 09/26/2024

PROJECT MANUAL FOR: CHEMISTRY BUILDING – 1<sup>ST</sup> FLOOR RENOVATION

PROJECT NUMBER: CP242331

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**END OF SECTION**

PLANNING DESIGN & CONSTRUCTION

General Services Bldg.  
Columbia, Missouri 65211  
Telephone: (573) 882-6800

ADVERTISEMENT FOR BIDS

Sealed bids for:

CHEMISTRY BUILDING –  
1<sup>ST</sup> FLOOR RENOVATION  
UNIVERSITY OF MISSOURI  
COLUMBIA, MISSOURI  
PROJECT NUMBER: CP242331

CONSTRUCTION ESTIMATE \$929,641 - \$1,032,934

will be received by the Curators of the University of Missouri, Owner, at Planning, Design & Construction, Room L100 (Front Reception Desk), General Services Building, University of Missouri, Columbia, Missouri 65211, until 1:30 p.m., C.T., October 17, 2024 and then immediately opened and publicly read aloud.

Drawings, specifications, and other related contract information may be obtained at <http://operations-webapps.missouri.edu/pdc/adsite/ad.html>. Electronic bid sets are available at no cost and may be printed as desired by the plan holders. No paper copies will be issued. If paper copies are desired, it is the responsibility of the user to print the files or have them printed.

Questions regarding the scope of work and commercial conditions should be directed to Design Services Project Manager Mark Hoerstkamp at (573) 882-2957 or [hoerstkampm@missouri.edu](mailto:hoerstkampm@missouri.edu).

A prebid meeting will be held at 1:30 p.m., C.T., October 1, 2024 in the General Services Bldg., Rm 194A, University of Missouri, Columbia, Missouri, followed by a site walk-through. All interested bidders are invited to attend this meeting.

A Diversity Participation goal of 10% MBE, 10% Combined WBE, DBE, Veteran Owned Business and 3% SDVE has been established for this contract.

The Owner reserves the right to waive informalities in bids and to reject any and all bids.

Individuals with special needs as addressed by the Americans with Disabilities Act may contact (573) 882-6800.

Advertisement Date: September 26, 2024

SECTION 1.A

BID FOR LUMP SUM CONTRACT

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

BID OF \_\_\_\_\_  
(hereinafter called "Bidder") a corporation\* organized and existing under laws of the State of \_\_\_\_\_,  
a partnership\* consisting of \_\_\_\_\_,  
an individual\* trading as \_\_\_\_\_,  
a joint venture\* consisting of \_\_\_\_\_.

\*Insert Corporation(s), partnership or individual, as applicable.

TO: Curators of the University of Missouri  
c/o Associate Vice Chancellor – Facilities  
Room L100, General Services Building  
University of Missouri  
Columbia, Missouri 65211

1. Bidder, in compliance with invitation for bids for construction work in accordance with Drawings and Specifications prepared by International Architects Atelier, entitled "Chemistry Building – 1<sup>st</sup> Floor Renovation", project number CP242331, dated September 26, 2024 having examined Contract Documents and site of proposed work, and being familiar with all conditions pertaining to construction of proposed project, including availability of materials and labor, hereby proposes to furnish all labor, materials and supplies to construct project in accordance with Contract Documents, within time set forth herein at prices stated below. Prices shall cover all expenses, including taxes not covered by the University of Missouri's tax exemption status, incurred in performing work required under Contract documents, of which this Bid is a part.

Bidder acknowledges receipt of following addenda:

Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____
Addendum No. _____	Dated _____

2. In following Bid(s), amount(s) shall be written in both words and figures. In case of discrepancy between words and figures, words shall govern.

3. BID PRICING

a. Base Bid:

The Bidder agrees to furnish all labor, materials, tools, and equipment required to renovate the first floor interior office suite of the Chemistry Building; all as indicated on the Drawings and described in these Specifications for sum of: \_\_\_\_\_

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

b. Additive Alternate Bids:

Above Base Bid may be changed in accordance with following Alternate Bids as Owner may elect. Alternates are as described in Section 1.H of Project Manual. Alternates are written in a priority order, but Owner is not required to accept or reject in order listed. This is a one (1) contract project, therefore, Alternates shall be studied by each Bidder to determine effect on Bids of Contractor and each Subcontractor and/or Material supplier.

(1) Additive Alternate No. 1:

Furnish all labor, materials, tools, and equipment required to renovate the first floor west portion of the interior lobby of the Chemistry Teaching Addition; all as indicated on the Drawings and described in these Specifications. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(2) Additive Alternate No. 2:

Furnish all labor, materials, tools, and equipment required to renovate the first floor east portion of the interior lobby of the Chemistry Teaching Addition; all as indicated on the Drawings and described in these Specifications. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

(3) Additive Alternate No. 3:

Furnish all labor, materials, tools, and equipment required to provide custom millwork elements for the first floor interior lobby of the Chemistry Teaching Addition; all as indicated on the Drawings and described in these Specifications. All for sum of:

\_\_\_\_\_ DOLLARS (\$\_\_\_\_\_).

d. Contingency Allowance:

Bidder shall include in the base bid sum a contingency allowance of seventy-two thousand dollars (\$72,000) for exclusive use by the Owner. This contingency allowance is to be used for changes in the Work as directed by the Owner's Representative. The Contractor shall submit their pricing in the same manner as described in Article 7 of the General Conditions included herein. Upon receipt and approval of change pricing, the Owner's Representative will authorize the use of these contingency funds. This Owner authorization will replace the formal change order. Use of any of these allowance funds requires written approval from the Owner's Representative prior to use. The contractor shall list this amount in the breakdown of costs as one line item and will be billable upon approval by the Owner's Representative and completion of the work. Any unused funds shall be returned to the Owner with a credit change order when requested by the Owner's Representative.

4. PROJECT COMPLETION

- a. Contract Period - Contract period begins on the day the Contractor receives unsigned Contract, Performance Bond, Payment Bond, and "Instructions for Execution of Contract, Bonds, and Insurance Certificates." Bidder agrees to complete the Base Bid scope of work within one hundred and eighty-seven (187) calendar days from receipt of aforementioned documents. If Alternate #1 is selected, the Contract period shall be extended by thirty (30) calendar days. If Alternate #2 and/or #3 is selected, the Contract period shall be extended by thirty (30) calendar days. Fifteen (15) calendar days have been allocated in construction schedule for receiving aforementioned documents from Bidder.
- b. Commencement - Contractor agrees to commence work on this project after the "Notice to Proceed" is issued by the Owner. "Notice to Proceed" will be issued within seven (7) calendar days after Owner receives properly prepared and executed Contract documents listed in paragraph 4.a. above.

5. SUBCONTRACTOR LIST:

Bidder hereby certifies that the following subcontractors will be used in performance of Work:

NOTE: Failure to list subcontractors for each category of work identified on this form or listing more than one subcontractor for any category of work without designating the portion of work performed by each shall be grounds for rejection of bid. List

name, city, and state of designated subcontractor, for each category of work listed in Bid For Lump Sum Contract. If work within a category will be performed by more than one subcontractor, Bidder shall provide name, city, and state of each subcontractor and specify exact portion of work to be performed by each. If acceptance/non-acceptance of Alternates will affect designation of a subcontractor, Bidder shall provide information, for each affected category, with this bid form. If Bidder intends to perform any designated subcontract work by using Bidder's own employees, then Bidder shall list their own name, city, and state. The bidder may petition the Owner to change a listed subcontractor only within 48 hours of the bid opening. See Information For Bidders Section 16 List of Subcontractors for requirements.

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Work to be performed                      Subcontractor Name, City, and State

---

**Mechanical** \_\_\_\_\_

**Electrical** \_\_\_\_\_

**Plumbing** \_\_\_\_\_

**6. SUPPLIER DIVERSITY PARTICIPATION GOALS**

- c. The Contractor shall have as a goal, subcontracting with Minority Business Enterprise (MBE) of ten percent (10%), with Women Business Enterprise (WBE), Disadvantage Business Enterprise (DBE), and/or Veteran Owned Business of ten percent (10%); and with Service Disabled Veteran Owned Business (SDVE) of three percent (3%) of awarded contract price for work to be performed.
- b. Requests for waiver of this goal shall be submitted on the attached Application For Waiver form. A determination by the Director of Facilities Planning & Development, UM, that a good faith effort has not been made by Contractor to achieve above stated goal may result in rejection of bid.
- c. The Undersigned proposes to perform work with following Supplier Diversity participation level:

MBE PERCENTAGE PARTICIPATION:  
 \_\_\_\_\_ percent ( \_\_\_\_\_ %)

WBE, DBE, and/or VETERAN PERCENTAGE PARTICIPATION

\_\_\_\_\_ percent (\_\_\_\_\_%)

SDVE PERCENTAGE PARTICIPATION:

\_\_\_\_\_ percent (\_\_\_\_\_%)

- d. A Supplier Diversity Compliance Evaluation form shall be submitted with this bid for each diverse subcontractor to be used on this project.

## 7. BIDDER'S ACKNOWLEDGMENTS

- a. Bidder declares that he has had an opportunity to examine the site of the work and he has examined Contract Documents therefore; that he has carefully prepared his bid upon the basis thereof; that he has carefully examined and checked bid, materials, equipment and labor required thereunder, cost thereof, and his figures therefore. Bidder hereby states that amount, or amounts, set forth in bid is, or are, correct and that no mistake or error has occurred in bid or in Bidder's computations upon which this bid is based. Bidder agrees that he will make no claim for reformation, modifications, revisions or correction of bid after scheduled closing time for receipt of bids.
- b. Bidder agrees that bid shall not be withdrawn for a period of ninety (90) days after scheduled closing time for receipt of bids.
- c. Bidder understands that Owner reserves right to reject any or all bids and to waive any informalities in bidding.
- d. Accompanying the bid is a bid bond, or a certified check, or a cashier's check payable without condition to "The Curators of the University of Missouri" which is an amount at least equal to five percent (5%) of amount of largest possible total bid herein submitted, including consideration of Alternates.
- e. Accompanying the bid is a Bidder's Statement of Qualifications. Failure of Bidder to submit the Bidder's Statement of Qualifications with the bid may cause the bid to be rejected. Owner does not maintain Bidder's Statements of Qualifications on file.
- f. It is understood and agreed that bid security of two (2) lowest and responsive Bidders will be retained until Contract has been executed and an acceptable Performance Bond and Payment Bond has been furnished. It is understood and agreed that if the bid is accepted and the undersigned fails to execute the Contract and furnish acceptable Performance/Payment Bond as required by Contract Documents, accompanying bid security will be realized upon or retained by Owner. Otherwise, the bid security will be returned to the undersigned.

8. BIDDER'S CERTIFICATE

Bidder hereby certifies:

- a. His bid is genuine and is not made in interest of or on behalf of any undisclosed person, firm or corporation, and is not submitted in conformity with any agreement or rules of any group, association or corporation.
- b. He has not directly or indirectly induced or solicited any other bidder to put in a false or sham bid.
- c. He has not solicited or induced any person, firm or corporation to refrain from bidding.
- d. He has not sought by collusion or otherwise to obtain for himself any advantage over any other Bidder or over Owner.
- e. He will not discriminate against any employee or applicant for employment because of race, color, religion, sex or national origin in connection with performance of work.
- f. By virtue of policy of the Board of Curators, and by virtue of statutory authority, a preference will be given to materials, products, supplies, provisions and all other articles produced, manufactured, mined or grown within the State of Missouri. By virtue of policy of the Board of Curators, preference will also be given to all Missouri firms, corporations, or individuals, all as more fully set forth in "Information For Bidders."

**END OF BIDDER'S CERTIFICATE**



9. BIDDER'S SIGNATURE

Note: All signatures shall be original; not copies, photocopies, stamped, etc.

Authorized Signature	Date
Printed Name	Title
Company Name	
Mailing Address	
City, State, Zip	
Phone No.	Federal Employer ID No.
Fax No.	E-Mail Address
Circle one:    Individual            Partnership            Corporation            Joint Venture	
If a corporation, incorporated under the laws of the State of _____	
Licensed to do business in the State of Missouri?    ___yes    ___no	

(Each Bidder shall complete bid form by manually signing on the proper signature line above and supplying required information called for in connection with the signature. Information is necessary for proper preparation of the Contract, Performance Bond and Payment Bond. Each Bidder shall supply information called for in accompanying "Bidder's Statement of Qualifications.")

**END OF SECTION**

**UNIVERSITY OF MISSOURI  
BIDDER'S STATEMENT OF QUALIFICATIONS**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name \_\_\_\_\_

Phone# \_\_\_\_\_ Fax #: \_\_\_\_\_

Address \_\_\_\_\_

2. Number of years in business \_\_\_\_\_. If not under present firm name, list previous firm names and types of organization.

\_\_\_\_\_  
\_\_\_\_\_

3. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

4. General character of work performed by your company personnel.

\_\_\_\_\_

5. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

6. Other experience qualifying you for the work now bid.

\_\_\_\_\_  
\_\_\_\_\_

7. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made \_\_\_\_\_

(b) Description of defaulted contracts and reason therefor

\_\_\_\_\_  
\_\_\_\_\_

8. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?

Yes \_\_\_\_\_ No \_\_\_\_\_

(b) Have you filed all required compliance reports?

Yes \_\_\_\_\_ No \_\_\_\_\_

- (c) Is fifty percent or more of your company owned by a minority?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (d) Is fifty percent or more of your company owned by a woman?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (e) Is fifty percent or more of your company owned by a service disabled veteran?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (f) Is fifty percent or more of your company owned by a veteran?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (g) Is your company a Disadvantaged Business Enterprise?  
Yes \_\_\_\_\_ No \_\_\_\_\_

9. Have you or your company been suspended or debarred from working at any University of Missouri campus?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If the answer is "yes", give details.)

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10. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If the answer is "yes", give details.)

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11. Workers Compensation Experience Modification Rates (last 3 yrs): \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
Incidence Rates (last 3 years): \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

12. List banking references.

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- 13. (a) Do you have a current confidential financial statement on file with Owner?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?  
Yes \_\_\_\_\_ No \_\_\_\_\_

Dated at \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_

---

Name of Organization

---

Signature

---

Printed Name

---

Title of Person Signing

END OF SECTION

**UNIVERSITY OF MISSOURI  
BIDDER'S STATEMENT OF QUALIFICATIONS FOR ASBESTOS ABATEMENT**

Submit with Bid for Lump Sum Contract in separate envelope appropriately labeled. Attach additional sheet if necessary.

1. Company Name \_\_\_\_\_ Phone# \_\_\_\_\_  
Address \_\_\_\_\_

2. State of Missouri Registration number \_\_\_\_\_

3. Number of years in business \_\_\_\_\_. If not under present firm name, list previous firm names and types of organization.

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4. List contracts on hand (complete the following schedule, include telephone number).

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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5. General character of work performed by your company personnel.

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6. List important projects completed in the last five (5) years on a type similar to the work now bid for, including approximate cost and telephone number.

Project & Address	Owner/Owner's Representative	Phone Number	Architect	Amount of your Contract	Percent Completed
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7. Other experience qualifying you for the work now bid.

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8. No default has been made in any contract complete or incomplete except as noted below:

(a) Number of contracts on which default was made \_\_\_\_\_  
(b) Description of defaulted contracts and reason therefor \_\_\_\_\_

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9. (a) Have you or your company participated in any contract subject to an equal opportunity clause similar to that described in the General Conditions?

Yes \_\_\_\_\_ No \_\_\_\_\_

(b) Have you filed all required compliance reports?

Yes \_\_\_\_\_ No \_\_\_\_\_

- (c) Is fifty percent or more of your company owned by a minority?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (d) Is fifty percent or more of your company owned by a woman?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (e) Is fifty percent or more of your company owned by a service disabled veteran?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (f) Is fifty percent or more of your company owned by a veteran?  
Yes \_\_\_\_\_ No \_\_\_\_\_
- (g) Is your company a Disadvantaged Business Enterprise?  
Yes \_\_\_\_\_ No \_\_\_\_\_

10. Have you or your company been suspended or debarred from working at any University of Missouri campus?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If the answer is "yes", give details.)

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11. Have any administrative or legal proceedings been started against you or your company alleging violation of any wage and hour regulations or laws?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If the answer is "yes", give details.)

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12. Workers Compensation Experience Modification Rates (last 3 yrs): \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_  
Incidence Rates (last 3 years): \_\_\_\_\_ / \_\_\_\_\_ / \_\_\_\_\_

13. List banking references.

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- 14. (a) Do you have a current confidential financial statement on file with Owner?  
Yes \_\_\_\_\_ No \_\_\_\_\_ (If not, and if desired, Bidder may submit such statement with bid, in a separate sealed and labeled envelope.)
- (b) If not, upon request will you file a detailed confidential financial statement within three (3) days?  
Yes \_\_\_\_\_ No \_\_\_\_\_

Dated at \_\_\_\_\_ this \_\_\_\_\_ day of \_\_\_\_\_ 20\_\_\_\_\_

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Name of Organization

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Signature

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Printed Name

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Title of Person Signing

END OF SECTION

**SUPPLIER DIVERSITY COMPLIANCE EVALUATION FORM**

This form shall be completed by Bidders and submitted with the Bidder's Statement of Qualifications form for each diverse firm who will function as a subcontractor on the contract.

The undersigned submits the following data with respect to this firm's assurance to meet the goal for Supplier Diversity participation.

I. Project: \_\_\_\_\_

II. Name of General Contractor: \_\_\_\_\_

III. Name of Diverse Firm: \_\_\_\_\_  
Address: \_\_\_\_\_

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

Status (check one) MBE \_\_\_\_\_ WBE \_\_\_\_\_ Veteran \_\_\_\_\_ Service Disabled Veteran \_\_\_\_\_ DBE \_\_\_\_\_

IV. Describe the subcontract work to be performed. (List Base Bid work and any Alternate work separately):

Base Bid: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

V. Dollar amount of contract to be subcontracted to the Diverse firm:  
Base Bid: \_\_\_\_\_

Alternate(s), (Identify separately): \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

VI. Is the proposed subcontractor listed in the Directory of M/W/DBE Vendors, Directory of Serviced Disabled Veterans and/or the Directory of Veterans maintained by the State of Missouri?

Yes \_\_\_\_\_ No \_\_\_\_\_

Is the proposed subcontractor certified as a diverse supplier by any of the following: federal government agencies, state agencies, State of Missouri city or county government agencies, Minority and/or WBE certifying agencies?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, please provide details and attach a copy of the certification.

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Does the proposed subcontractor have a signed document from their attorney certifying the Supplier as a Diverse and meeting the 51% owned and committed requirement?

Yes \_\_\_\_\_

No \_\_\_\_\_

If yes, please attach letter.

Signature:

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Name:

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Title:

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Date:

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**APPLICATION FOR WAIVER**

This form shall be completed and submitted with the Bidder's Statement of Qualifications. Firms wishing to be considered for award are required to demonstrate that a good faith effort has been made to include diverse suppliers. This form will be used to evaluate the extent to which a good faith effort has been made. The undersigned submits the following data with respect to the firm's efforts to meet the goal for Supplier Diversity Participation.

1. List pre-bid conferences your firm attended where Supplier Diversity requirements were discussed.

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2. Identify advertising efforts undertaken by your firm which were intended to recruit potential diverse subcontractors for various aspects of this project. Provide names of newspapers, dates of advertisements and copies of ads that were run.

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3. Note specific efforts to contact in writing those diverse suppliers capable of and likely to participate as subcontractors for this project.

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4. Describe steps taken by your firm to divide work into areas in which diverse suppliers/contractors would be capable of performing.

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5. What efforts were taken to negotiate with prospective diverse suppliers/contractors for specific sub-bids? Include the names, addresses, and telephone numbers of diverse suppliers/contractors contacted, a description of the information given to diverse suppliers/contractors regarding plans and specifications for the assigned work, and a statement as to why additional agreements were not made with diverse suppliers/contractors.

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6. List reasons for rejecting a diverse supplier/contractor which has been contacted.

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8. Describe the follow-up contacts with diverse suppliers/contractors made by your firm after the initial solicitation.

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9. Describe the efforts made by your firm to provide interested diverse suppliers/contractors with sufficiently detailed information about the plans, specifications and requirements of the contract.

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10. Describe your firm's efforts to locate diverse suppliers/contractors.

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Based on the above stated good faith efforts made to include supplier diversity, the bidder hereby requests that the original supplier diversity percentage goal be waived and that the percentage goal for this project be set at \_\_\_\_\_ percent.

The undersigned hereby certifies, having read the answers contained in the foregoing Application for Waiver, that they are true and correct to the best of his/her knowledge, information and belief.

Signature \_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_

Company \_\_\_\_\_

Date \_\_\_\_\_

**AFFIDAVIT**

"The undersigned swears that the foregoing statements are true and correct and include all material information necessary to identify and explain the operation of \_\_\_\_\_ (name of firm) as well as the ownership thereof. Further, the undersigned agrees to provide through the prime contractor or directly to the Contracting Officer current, complete and accurate information regarding actual work performed on the project, the payment therefore and any proposed changes, if any, of the project, the foregoing arrangements and to permit the audit and examination of books, records and files of the named firm. Any material misrepresentation will be grounds for terminating any contract which may be awarded and for initiating action under federal or state laws concerning false statements."

Note - If, after filing this information and before the work of this firm is completed on the contract covered by this regulation, there is any significant change in the information submitted, you must inform the Director of Facilities Planning and Development of the change either through the prime contractor or directly.

Signature \_\_\_\_\_

Name \_\_\_\_\_

Title \_\_\_\_\_

Date \_\_\_\_\_

Corporate Seal (where appropriate)

Date \_\_\_\_\_

State of \_\_\_\_\_

County of \_\_\_\_\_

On this \_\_\_\_\_ day of \_\_\_\_\_, 19\_,  
before me appeared (name) \_\_\_\_\_ to me personally known, who, being  
duly sworn, did execute the foregoing affidavit, and did state that he or she was properly authorized by (name of firm)

\_\_\_\_\_  
\_\_\_\_\_ to execute the affidavit and did so as his or her own free act and deed.

(Seal)

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

Commission expires \_\_\_\_\_

**AFFIDAVIT FOR AFFIRMATIVE ACTION**

State of Missouri                    )  
  )  
County of                                )                    ss.

\_\_\_\_\_ first being duly sworn on his/her oath states: that he/she is the (sole proprietor, partner, or officer) of \_\_\_\_\_ a (sole proprietorship, partnership, corporation), and as such (sole proprietor, partner, or officer) is duly authorized to make this affidavit on behalf of said (sole proprietorship, partnership, corporation); that under the contract known as " \_\_\_\_\_ " Project No. \_\_\_\_\_ less than 50 persons in the aggregate will be employed and therefore, the applicable Affirmative Action requirements as set forth in the "Nondiscrimination in Employment Equal Opportunity," Supplemental Special Conditions, and Article 13 in the General Conditions do not apply.

\_\_\_\_\_

Subscribed and sworn before me this \_\_\_\_\_ day of \_\_\_\_\_, 19\_\_\_\_\_.

My commission expires \_\_\_\_\_, 19\_\_\_\_\_.

## CERTIFYING SUPPLIER DIVERSITY AGENCIES

Diverse firms are defined in General Conditions Articles 1.1.7 and those businesses must be certified as disadvantaged by an approved agency. The Bidder is responsible for obtaining information regarding the certification status of a firm. A list of certified firms may be obtained by contacting the agencies listed below. Any firm listed as disadvantaged by any of the following agencies will be classified as a diverse firm by the Owner.

St. Louis Development Corporation  
1520 Market St., Ste. 2000  
St. Louis, MO 63103  
P: 314.982.1400  
W: [www.stlouis-mo.gov/slcdc/](http://www.stlouis-mo.gov/slcdc/)

Bi-State Development  
211 N. Broadway, Ste. 700  
St. Louis, MO 63102  
P: 314.982.1400  
W: [www.metrostlouis.dbesystem.com](http://www.metrostlouis.dbesystem.com)

St. Louis Minority Business Council  
211 N. Broadway, Ste. 1300  
St. Louis, MO 63102  
P: 314.231.5555  
W: [www.slmbc.org](http://www.slmbc.org)

U.S. Small Business Administration - St. Louis, MO  
8(a) Contractors, Minority Small Business  
1222 Spruce Street, Suite 10.103  
St. Louis, MO 63101  
P: 314.539.6600  
W: [www.sba.gov](http://www.sba.gov)

Lambert St. Louis International Airport  
Business Diversity Development Office  
11495 Navaid  
Bridgeton, MO 63044  
P: 314-426-8111  
W: [www.flystl.com/business/business-diversity-development-1/directories](http://www.flystl.com/business/business-diversity-development-1/directories)

City of Kansas City, Missouri  
Human Relations Department, MBE/WBE Division  
4th Floor, City Hall  
414 E. 12<sup>th</sup> Street  
Kansas City, MO 64106  
P: 816.513.1836  
W: [kcmohrd.mwdbe.com/?TN=kcmohrd](http://kcmohrd.mwdbe.com/?TN=kcmohrd)

Mid-States Minority Supplier Development Council  
505 N. 7<sup>th</sup> Street, Ste. 1820  
St. Louis, MO 63101  
P: 314.278.5616  
W: [midstatesdc.org](http://midstatesdc.org)

U.S. Small Business Administration - Kansas City, MO  
8(a) Contractors, Minority Small Business  
1000 Walnut, Suite 500  
Kansas City, MO 64106  
P: 816.426.4900  
W: [kcmohrd.mwdbe.com/?TN=kcmohrd](http://kcmohrd.mwdbe.com/?TN=kcmohrd)

Missouri Department of Transportation  
Division of Construction  
1617 Missouri Blvd.  
P.O. Box 270  
Jefferson City, MO 65102  
P: 573.526.2978  
W: [www.modot.org/mrcc-directory](http://www.modot.org/mrcc-directory)

Illinois Department of Transportation  
MBE/WBE Certification Section  
2300 Dirksen Parkway  
Springfield, IL 62764  
217/782-5490; 217/785-1524 (Fax)  
W: [webapps.dot.illinois.gov/UCP/ExternalSearch](http://webapps.dot.illinois.gov/UCP/ExternalSearch)

State of Missouri OA  
Office of Equal Opportunity  
301 W. High St. HSC Rm 870-B  
Jefferson City, MO 65101  
P: 877.259.2963  
W: [oa.mo.gov/sites/default/files/sdvelisting.pdf](http://oa.mo.gov/sites/default/files/sdvelisting.pdf)  
[oeo.mo.gov/](http://oeo.mo.gov/)

## Minority Newspapers

Dos Mundos Bilingual Newspaper  
902A Southwest Blvd.  
Kansas City, MO 64108  
816-221-4747  
[www.dosmundos.com](http://www.dosmundos.com)

Kansas City Hispanic News  
2918 Southwest Blvd.  
Kansas City, MO 64108  
816/472-5246  
[www.kchispanicnews.com](http://www.kchispanicnews.com)

The Kansas City Globe  
615 E. 29th Street  
Kansas City, MO 64109  
816-531-5253  
[www.thekcglobe.com/about\\_us.php](http://www.thekcglobe.com/about_us.php)

St. Louis American  
4144 Lindell  
St. Louis, MO 63108  
314-533-8000  
[www.stlamerican.com](http://www.stlamerican.com)

St. Louis Chinese American News  
1766 Burns Ave, Suite 201  
St. Louis, MO 63132  
314-432-3858  
[www.scanews.com](http://www.scanews.com)

St. Louis Business Journal  
815 Olive St., Suite 100  
St. Louis, MO 63101  
314-421-6200  
[www.bizjournal.com/stlouis](http://www.bizjournal.com/stlouis)

Kansas City Business Journal  
1100 Main Street, Suite 210  
Kansas City, MO 64105  
816-421-5900  
[www.bizjournals.com/kansascity](http://www.bizjournals.com/kansascity)

## **AFFIDAVIT OF SUPPLIER DIVERSITY PARTICIPATION**

The apparent low Bidder shall complete and submit this form within 48 hours of bid opening for each Diverse firm that will participate on the contract.

1. Diverse Firm: \_\_\_\_\_  
 Contact Name: \_\_\_\_\_  
 Address: \_\_\_\_\_  
 Phone No.: \_\_\_\_\_ E-Mail: \_\_\_\_\_

Status (check one) MBE  WBE  Veteran  Service Disabled Veteran  DBE   
 If MBE, Certified as (circle one): 1) Black American 2) Hispanic American 3) Native American 4) Asian American

2. Is the proposed diverse firm certified by an approved agency [see IFB article 15]? Yes  No

Agency: \_\_\_\_\_ [attach copy of certification authorization from agency]

Certification Number: \_\_\_\_\_

3. Diverse firm scope work and bid/contract dollar amount of participation (List Base Bid and Alternate work separately). The final Dollar amount will be determined at substantial completion:

	Scope of Work	Bid/Contract Amount	Final Dollar Amount
Base Bid			
Alternate #1			
Alternate #2			
Alternate #3			
Alternate #4			
Alternate #5			
Alternate #6			

The undersigned certifies that the information contained herein (i.e. Scope of Work and Bid/Contract Amount) is true and correct to the best of their knowledge, information and belief.

General Contractor: \_\_\_\_\_ Diverse Firm: \_\_\_\_\_

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

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

Title: \_\_\_\_\_ Title: \_\_\_\_\_

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

The undersigned certifies that the information contained herein (i.e. Scope of Work and Final Dollar Amount) is true and correct to the best of their knowledge, information and belief. If the Final Dollar Amount is different than the Bid/Contract Amount, then attach justification for the difference.

Contractor: \_\_\_\_\_ Diverse Firm: \_\_\_\_\_

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

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

Title: \_\_\_\_\_ Title: \_\_\_\_\_

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

**University of Missouri**  
**INFORMATION FOR BIDDERS**

	Page No.
1. Contract Documents and Definitions.....	IFB/1
2. Bidder’s Obligation .....	IFB/1
3. Interpretation of Documents.....	IFB/1
4. Bids.....	IFB/1
5. Modification and Withdrawal of Bids .....	IFB/2
6. Signing of Bids .....	IFB/2
7. Bid Security .....	IFB/2
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14. Missouri Products and Missouri Firms .....	IFB/4
15. Supplier Diversity .....	IFB/4
16. List of Subcontractors.....	IFB/6

## **1. Contract Documents and Definitions**

**1.1** The “Drawings,” “Specifications,” and “Contract Documents” are defined in the “General Conditions of the Contract for Construction.”

**1.2** The Drawings, Specifications, and other Contract Documents may be obtained as indicated in the Advertisement for Bids.

**1.3** As used herein, “Bid” refers to an offer or proposal submitted to the Owner to enter into a contract for the work identified in the Drawings, Specifications and other Contract Documents.

**1.4** As used herein, “Bidder” means an individual or business entity that submits a Bid to the Owner as a prime bidder or general contractor.

**1.5** All other terms used herein shall have the meanings defined herein or in the General Conditions of the Contract for Construction or other Contract Documents.

## **2. Bidder Obligations**

**2.1** Before submitting a Bid, each Bidder shall carefully examine the Drawings and Specifications and related Contract Documents, visit the site of the work, and fully inform themselves as to all existing conditions, facilities, restrictions, and other matters that could affect the work or the cost thereof.

**2.2** Each Bidder shall include in their Bid the cost of all work and materials required to complete the contract in a first-class manner, as specified in the Drawings, Specifications, and other Contract Documents. All work shall be done as defined in the Specifications and as indicated on the Drawings.

**2.3** Failure or omission of any Bidder to receive or to examine any form, instrument, addendum, or other document, or to visit the site of the work and acquaint themselves with existing conditions, shall in no way relieve the Bidder from any obligation with respect to their Bid or any awarded contract. No extra compensation will be allowed concerning any matter about which the Bidder should have fully informed themselves prior to submitting a Bid.

**2.4** Submission of a Bid shall be deemed acceptance by the Bidder of the above obligations and every obligation required by the Contract Documents in the event the Bid is accepted by the Owner.

## **3. Interpretation of Documents**

**3.1** If any prospective Bidder is in doubt about the meaning of any part of the Drawings, Specifications, or

other Contract Documents, the Bidder shall submit a written request to the Architect for an interpretation.

**3.2** Any request for interpretation shall be delivered to the Architect at least one (1) week prior to time for receipt of bids.

**3.3** A Bid shall be based only on an interpretation issued in the form of an addendum mailed to each person or business entity that is on the Architect’s record as having received a set of the Contract Documents.

**3.4** Bidders shall not be entitled to rely on oral interpretations or written statements not issued in an addendum from either the Architect or a representative, agent, or employee of the Owner.

## **4. Bids**

**4.1** Bids shall be submitted on a single “Bid for Lump Sum Contract” form (“Bid Form”) as furnished by the Owner or Architect. Bids shall be received separately or in combination as required by Bid Form

**4.2** In addition to the Bid Form, the Bid shall include any documents or information required to be submitted by this Information for Bidders or the Contract Documents.

**4.3** Bids shall include amounts for alternate bids, unit prices, and cost accounting data where required by the Bid Form.

**4.4** Bidders shall apportion each base Bid between various phases of the work, where stipulated in the Bid Form.

**4.5** Bids shall be presented in sealed envelopes, which shall be plainly marked “Bids for (indicate name of project from cover sheet)” and mailed or delivered to the building and room number specified in the Advertisement for Bids.

**4.6** Each Bidder shall be responsible for actual delivery of their bid during business hours, and it shall not be sufficient to show that a Bid was mailed in time to be received before scheduled closing time for receipt of bids, nor shall it be sufficient to show that a Bid was somewhere in a university facility.

**4.7** The Bidder’s price shall include all federal sales, excise, and similar taxes that may be lawfully assessed in connection with their performance of work and purchase of materials to be incorporated in the work. City and State taxes shall not be included as stated in the General Conditions of the Contract for Construction.



4.8 No Bidder shall stipulate in their Bid any conditions not contained in the Bid Form or Contract Documents. Inclusion of any additional conditions or taking exception to any terms may result in rejection of the Bid.

4.9 The Owner reserves the right to waive informalities in bids and to reject any or all bids.

#### **5. Modification and Withdrawal of Bids**

5.1 A Bidder may withdraw their Bid at any time before the scheduled closing time for receipt of bids. No Bidder may withdraw their Bid after the scheduled closing time for receipt of bids.

5.2 Only a written request for modification or correction of a previously submitted Bid, contained in a sealed envelope that is plainly marked "Modification of Bid on (name of project on cover sheet)," which is addressed in the same manner as a Bid and received by Owner before the scheduled closing time for receipt of bids, will be accepted and the Bid modified in accordance with such written request.

#### **6. Signing of Bids**

6.1 All bids shall be signed manually, by an individual authorized to sign on behalf of the Bidder. The title or office held by the person signing for the Bidder shall appear below the signature.

6.2 A Bid should contain the full and correct legal name of the Bidder. If the Bidder is an entity registered with the Missouri Secretary of State, the Bidder's name on the Bid form should appear as shown in the Secretary of State's records.

6.3 A Bid from a partnership or joint venture shall be signed in the name of the partnership or joint venture by at least one partner or joint venturer or by an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid executed by all partners or joint venturers.

6.4 A Bid from a corporation shall be signed by an officer of the corporation.

6.5 A Bid from a limited liability company (LLC) shall be signed by a manager or a managing member of the LLC.

6.6 A Bid from an individual or sole proprietor shall be signed in the name of the individual by the individual or an Attorney-in-Fact. If signed by Attorney-in-Fact there should be attached to the Bid, a Power of Attorney evidencing authority to sign the Bid

executed by the individual.

#### **7. Bid Security**

7.1 Each Bid shall be accompanied by a Bid Bond, certified check, or cashier's check, acceptable to and payable without condition to "The Curators of the University of Missouri" in an amount at least equal to five percent (5%) of the Bidder's Bid including additive alternates ("Bid Security").

7.2 Bid security is required as a guarantee that the Bidder will enter into a written contract and furnish a Performance Bond within the time and in form as specified herein or in the Contract Documents; and, if successful Bidder fails to do so, the Bid Security will be realized upon or retained by the Owner. The apparent low Bidder shall notify the Owner in writing within forty-eight (48) hours of the Bid opening of any circumstance that may affect the Bid Security including, but not limited to, an error in the Bid. This notification will not guarantee release of the Bidder's security and/or the Bidder from the Bidder's obligations.

7.3 If a Bid Bond is given as a Bid Security, the amount of the Bid Bond may be stated as an amount equal to at least five percent (5%) of the Bid, including additive alternates, described in the Bid. The Bid Bond shall be executed by the Bidder and a responsible surety licensed in the State of Missouri with a Best's rating of no less than A-/XL.

7.4 It is specifically understood that the Bid Security is a guarantee and shall not be considered as liquidated damages for failure of Bidder to execute and deliver the contract and Performance Bond, nor limit or fix the Bidder's liability to the Owner for any damages sustained because of failure to execute and deliver the required contract and Performance Bond.

7.5 The Bid Security of the two (2) lowest, responsive, responsible bidders will be retained by the Owner until a contract has been executed and an acceptable Performance Bond has been furnished, as required hereby, when such Bid Security will be returned. The Bid Bonds of all other Bidders will be destroyed and all other alternative forms of Bid Security will be returned to them within ten (10) days after the Owner has determined the two (2) lowest, responsive, responsible bids.

#### **8. Bidder's Statement of Qualifications**

8.1 Each Bidder shall present evidence of their experience, qualifications, financial responsibility, and ability to carry out the terms of the contract by completing and submitting with their Bid the "Bidder's Statement of Qualifications" form included with the Bid

documents.

**8.2** Financial information required to be included with the Statement of Qualifications may be submitted by the Bidder in a separately sealed envelope, which will not be opened by the Owner during the public Bid opening.

**8.3** The Bidder's Statement of Qualifications will be treated as confidential information by the Owner to the extent permitted by the Missouri Sunshine Law, Section 610.010, RSMo et seq.

**8.4** Bids not accompanied by the Bidder's Statement of Qualifications may be rejected.

## **9. Award of Contract**

**9.1** The Owner reserves the right to let other contracts in connection with the work, including, but not limited to, contracts for furnishing and installation of furniture, equipment, machines, appliances, and other apparatus.

**9.2** In awarding the contract, the Owner may take into consideration the ability of the Bidder, and their subcontractors, to handle promptly the additional work; the skill, facilities, capacity, experience, ability, responsibility, previous work, and financial standing of Bidder; the Bidder's ability to provide the required bonds and insurance; the quality, efficiency and construction of equipment proposed to be furnished; the period of time within which equipment is proposed to be furnished and delivered; success in achieving the specified Supplier Diversity Goals or demonstrating a good faith effort to do so as described in Article 15 of this document; and the Bidder's status as suspended or debarred. Inability of any Bidder to meet the requirements mentioned above may be cause for rejection of their Bid.

## **10. Contract Execution**

**10.1** The awarded Bidder shall submit within fifteen (15) days from receipt of notice of award, the documents required in Article 9 of the General Conditions of the Contract for Construction.

**10.2** No bids will be considered binding upon the Owner until all such required documents have been furnished. Failure of Contractor to execute and submit such documents within the time specified will be treated, at the option of the Owner, as a breach of the Bidder's Bid Security and the Owner shall be under no further obligation to the Bidder.

## **11. Contract Security**

**11.1** When the Contract Sum exceeds \$50,000, the

Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner. Each bond shall be in the amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of the Contract, including but not limited to the Contractor's obligation to correct any defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under the Contract and furnishing materials in connection with the Contract in accordance with Section 107.170, RSMo. These bonds shall be in effect through the duration of the Contract plus any Guaranty Period required by the Contract Documents.

**11.2** The bonds required hereunder shall be meet all requirements of Article 11 of the General Conditions of the Contract for Construction.

**11.3** If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Article 11, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If the Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of Contractor at Contractor's expense.

## **12. Time of Completion**

**12.1** The awarded Contractor shall agree to commence work within five (5) days of the date "Notice to Proceed" is received from the Owner, and the entire work shall be completed by the completion date specified or within the number of consecutive calendar days stated in the Special Conditions. The duration of the construction period, when specified in consecutive calendar days, shall begin when the contractor receives notice requesting the documents required in Article 9 of the General Conditions of the Contract for Construction.

## **13. Number of Contract Documents**

**13.1** The Owner will furnish the Contractor a copy of the executed contract, Performance Bond, and Payment Bond.

**13.2** The Owner will furnish the Contractor the number of copies of complete sets of Drawings and Specifications for the work, as well as clarification and change order Drawings pertaining to change orders required during construction as set forth in the Special Conditions.

#### **14. Missouri Products and Missouri Firms**

**14.1** The Curators of the University of Missouri have adopted a policy which is binding upon all employees and departments of the University of Missouri, and which by contract, shall be binding upon independent contractors and subcontractors with the University of Missouri whereby all other things being equal, and when the same can be secured without additional cost over foreign products, or products of other states, a preference shall be granted in all construction, repair and purchase contracts, to all products, commodities, materials, supplies, and articles mined, grown, produced, and manufactured in marketable quantity and quality in the State of Missouri, and to all firms, corporations or individuals doing business as Missouri firms, corporations, or individuals. Each Bidder submitting a Bid agrees to comply with and be bound by the foregoing policy.

#### **15. Supplier Diversity**

##### **15.1 Award of Contract**

**15.1.1** The Bidder shall have a minimum goal of providing participation of Diverse Firms in the project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as subcontractors, suppliers, or manufacturers, in the amount of the percent of contract price stated in the Bid Form ("Supplier Diversity Goals"). The Owner will take into consideration the Bidder's success in achieving the Supplier Diversity Goals in awarding the contract. Inability of any Bidder to meet one or more of the Supplier Diversity Goals may be cause for rejection of their Bid, unless the Bidder has demonstrated that they made a good faith effort to comply as set forth below.

**15.1.2** In addition to the Supplier Diversity Goals set forth in the Bid Form, a three (3) point bonus preference will be given to a Bidder that is a certified Service-Disabled Veteran Enterprises (SDVE) business doing business as Missouri firm, corporation, or individual, or that maintains a Missouri office or place of business. The bonus preference will **not** be given to a Bidder for the use of SDVE subcontractors, suppliers, or manufacturers. The bonus preference shall be calculated and applied by reducing the Bid amount of the SDVE Bidder by three (3) percent of the apparent low, responsive Bidder's Bid. Based on this calculation, if the SDVE Bidder's resulting total Bid valuation is less than the Bid of the apparent low, responsive Bidder, the SDVE Bid becomes the apparent low, responsive Bid. This reduction is for evaluation purposes only and will have no impact on the actual amount(s) of the SDVE Bidder's Bid or the amount(s) of any contract awarded.

##### **15.2 List of Diverse Firms**

**15.2.1** The Bidder shall submit, within forty-eight (48) hours of the receipt of bids to the University Contracting Officer, a list of Diverse Firms that will be performing as contractor, subcontractor, supplier, or manufacturer on the project. The list shall separately identify each Diverse Firm by name and address. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, supplier, or manufacturer, the Bidder shall provide information for each affected category.

**15.2.2** Failure to include a complete list of Diverse Firms that will be used to meet the Supplier Diversity Goals may be grounds for rejection of the Bid.

**15.2.3** The list of Diverse Firms shall be submitted in addition to any other listing of subcontractors required in the Bid Form or elsewhere in this document.

##### **15.3 Supplier Diversity Goal Computation**

**15.3.1** The Bidder may count toward the Supplier Diversity Goal only expenditures to Diverse Firms that perform a commercially useful function in the work of a contract. A Diverse Firm is considered to perform a commercially useful function when it is responsible for executing a distinct element of the work or contract and is carrying out its responsibilities by actually performing managing and supervising the work.

**15.3.2** The Bidder may count toward its Supplier Diversity Goals work granted to a second or subsequent tier subcontractor that is a Diverse Firm provided the Diverse Firm assumes the actual and contractual responsibility for performing work on the project. The Bidder may count toward its Supplier Diversity Goals expenditures for materials and/or supplies obtained from a Diverse Firm, provided the Diverse Firm assumes the actual and contractual responsibility for the provision of the materials and/or supplies. To perform a commercially useful function, a supplier or manufacturer that is a Diverse Firm must be responsible for negotiating price, determining quality and quantity, ordering the material, installing (where applicable) and paying for the material itself.

**15.3.3** A Diverse Firm does not perform a commercially useful function if its role is solely that of an extra participant in a transaction, contract, or project through which funds are passed in order to obtain the appearance of participation. In determining whether a firm is such an extra participant, the Owner will examine similar transactions, particularly those in which Diverse Firms do not participate.

**15.3.4** A Bidder that is a certified Diverse Firm may count one hundred percent 100% of the contract amount

towards the applicable Supplier Diversity Goal(s), less any amounts awarded to another Diverse Firm. For projects with separate Supplier Diversity Goals, the Bidder will be required to obtain participation in the other categories for which it is not certified through participation by subcontractors, suppliers, or manufacturers. Therefore, an MBE Bidder is expected to obtain the required SDVE and WBE/DBE/Veteran participation; a WBE/DBE/Veteran Bidder is expected to obtain the required MBE and SDVE participation; and a SDVE Bidder is expected to obtain the required MBE and WBE/DBE/Veteran participation.

**15.3.5** If the Bidder is a joint venture and the joint venture itself is certified as a Diverse Firm, the joint venture may count toward the Supplier Diversity Goals that portion of the total dollar value of the work equal to the percentage of the ownership and control of the Diverse Firm participant in the joint venture. When a Diverse Firm performs work as a participant in a joint venture where the joint venture is **not** separately certified as a Diverse Firm, only the portion of the Contract Sum equal to the distinct, clearly defined portion of the work that the Diverse Firm performs with its own forces shall count toward the Supplier Diversity Goals.

**15.3.6** If a Diverse Firm is certified in more than one Supplier Diversity category, that Diverse Firm may be used to satisfy more than one Supplier Diversity goal, provided that the Diverse Firm is awarded a sufficient percentage of the contract work to meet or exceed all applicable Supplier Diversity Goals.

#### **15.4 Certification of Diverse Firms**

**15.4.1** The Bidder shall submit, within forty-eight (48) hours of the time for receipt of bids, to the University Contracting Officer, the information requested in the "Supplier Diversity Compliance Evaluation Form" for every Diverse Firm the Bidder intends to award work to under the contract to meet the Supplier Diversity Goals.

**15.4.2** "Diverse Firm" is defined in Article 1 of the General Conditions of the Contract for Construction. The Bidder is responsible for obtaining information regarding the certification status of a Diverse Firm. A list of certified Diverse Firms may be obtained by contacting the agencies listed in the document entitled "Supplier Diversity Certifying Agencies."

**15.4.3** Bidders are urged to encourage their prospective subcontractors, joint venture participants, team partners, suppliers and manufacturers who are Diverse Firms but are not currently certified to obtain certification from one of the approved agencies prior to

bidding.

#### **15.5 Supplier Diversity Participation Waiver**

**15.5.1** The Bidder is required to make a good faith effort to locate and contract with Diverse Firms. If a Bidder has made a good faith effort to secure the required Supplier Diversity Participation and has failed, the Bidder shall submit within forty-eight (48) hours of the time for receipt of bids to the University Contracting Officer, the information requested in "Application for Supplier Diversity Participation Waiver." The Contracting Officer will review the Bidder's actions as set forth in the Bidder's "Application for Waiver" and any other factors deemed relevant by the Contracting Officer to determine if a good faith effort has been made to meet the Supplier Diversity Goal(s). If the Bidder is judged not to have made a good faith effort, the Bid may be rejected. Bidders who demonstrate that they have made a good faith effort to meet the Supplier Diversity Goal(s) may be awarded the contract regardless of the actual percent of Supplier Diversity Participation, provided that the Bid is otherwise acceptable and is determined to be the lowest, responsive, responsible Bid.

**15.5.2** To determine the good faith effort of the Bidder, the Contracting Officer may evaluate factors including, but not limited to, the following:

**15.5.2.1** The Bidder's attendance at pre-proposal meetings scheduled to inform Diverse Firms of contracting and subcontracting opportunities and responsibilities associated with Supplier Diversity Participation.

**15.5.2.2** The Bidder's advertisements in general circulation trade association, and diverse (minority) focused media concerning subcontracting opportunities.

**15.5.2.3** The Bidder's written notice to specific Diverse Firms that their services were being solicited in sufficient time to allow for their effective participation.

**15.5.2.4** The Bidder's follow-up attempts to the initial solicitation(s) to determine with certainty whether Diverse Firms were interested.

**15.5.2.5** The Bidder's efforts to divide the work into packages suitable for subcontracting to Diverse Firms.

**15.5.2.6** The Bidder's efforts to provide interested Diverse Firms with sufficiently detailed information about the Drawings, Specifications and requirements of the contract, and clear scopes of work for the Diverse Firms to bid on.

**15.5.2.7** The Bidder's efforts to solicit for specific sub-bids from Diverse Firms in good faith. Documentation should include names, addresses, and telephone numbers of Diverse Firms contacted, a description of all information provided to the Diverse Firms, and an explanation as to why agreements were not reached.

**15.5.2.8** The Bidder's efforts to locate Diverse Firms not on the directory list and assist Diverse Firms in becoming certified as such.

**15.5.2.9** The Bidder's initiatives to encourage and develop participation by Diverse Firms.

**15.5.2.10** The Bidder's efforts to help Diverse Firms overcome legal or other barriers impeding the participation of Diverse Firms in the construction contract.

**15.5.2.11** The availability of Diverse Firms and the adequacy of the Bidder's efforts to increase the participation of such business provided by the persons and organizations consulted by the Bidder.

## **15.6 Submittal of Forms**

**15.6.1** Within forty-eight (48) hours of the time for receipt of bids, the apparent low Bidder shall submit to the University Contracting Officer all Supplier Diversity Compliance Evaluation Form(s), and/or Application for Waiver with supporting information, and an "Affidavit of Supplier Diversity Participation" for every Diverse Firm the Bidder intends to award work on the contract. The affidavit will be signed by both the Bidder and the Diverse Firm. Failure to submit the documents in the time indicated may result in rejection of the Bid.

## **15.7 Additional Bid/Proposer Information**

**15.7.1** The Contracting Officer reserves the right to request from the apparent low Bidder additional information regarding the Bidder's proposed Supplier Diversity Participation and supporting documentation. The Bidder shall respond in writing to the Contracting Officer within twenty-four (24) hours of a request.

**15.7.2** The Contracting Officer reserves the right to request additional information after the Bidder has responded to prior requests. This information may include follow up and/or clarification of the information previously submitted.

**15.7.3** The Owner reserves the right to consider additional Supplier Diversity Participation submitted by the Bidder after bids are opened. The Owner may

elect to waive the good faith effort requirement if such additional participation achieves the Supplier Diversity Goal.

**15.7.4** The Bidder shall provide to the Owner information related to the Supplier Diversity Participation included in the Bidder's proposal, including, but not limited to, the complete Application for Waiver, evidence of certification of participating Diverse firms, dollar amount of participation of Diverse Firms, information supporting a good faith effort as described above, and a list of all Diverse Firms that submitted bids to the Bidder with the Diverse Firm's price, and the name and the price of the firm awarded the scope of work.

## **16. List of Subcontractors**

**16.1** If a list of subcontractors is required on the Bid Form, the Bidder shall list the name, city, and state of the firm(s) that will accomplish that portion of the contract requested in the space provided. This list is separate from both the list of Diverse Firms required in Section 15.2 and the complete list of subcontractors required in Section 10.1 of this document. Should the Bidder choose to perform any of the listed portions of the work with its own forces, the Bidder shall enter its own name, city, and state in the space provided. If acceptance or non-acceptance of alternates will affect the designation of a subcontractor, the Bidder shall provide that information on the Bid Form.

**16.2** Failure of the Bidder to supply the list of subcontractors required or the listing of more than one subcontractor for any category without designating the portion of the work to be performed by each, shall be grounds for the rejection of the Bid. The Bidder can petition the Owner to change a listed subcontractor within forty-eight (48) hours of the Bid opening. The Owner reserves the right to make the final determination on a petition to change a subcontractor. The Owner will consider factors such as clerical and mathematical errors in the Bid, a listed subcontractor's inability to perform the work, etc. Any request to change a listed subcontractor shall include at a minimum, a Bid sheet showing tabulation of the Bid; all subcontractor bids with documentation of the time they were received by the contractor; and a letter from the listed subcontractor on their letterhead stating why they cannot perform the work if applicable. The Owner reserves the right to ask for additional information.

**16.3** Upon award of the contract, the requirements of Article 10 herein and Article 5 of the General Conditions of the Contract for Construction will apply.

University of Missouri

**General Conditions**

of the

**Contract**

for

**Construction**

July 2024 Edition

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**ARTICLE 1  
GENERAL PROVISIONS**

**1.1 Basic Definitions**

As used in the Contract Documents, the following terms shall have the meanings and refer to the parties designated in these definitions.

**1.1.1 Owner**

The Owner is The Curators of the University of Missouri. The Owner may act through its Board of Curators or any duly authorized committee or representative thereof. The Owner may also be referred to herein as "University".

**1.1.2 Contracting Officer**

The Contracting Officer is the duly authorized representative of the Owner with the authority to execute contracts. Communications to the Contracting Officer shall be forwarded via the Owner's Representative.

**1.1.3 Owner's Representative**

The Owner's Representative is authorized by the Owner as the administrator of the Contract and will represent the Owner during the progress of the Work. Communications from the Architect to the Contractor and from the Contractor to the Architect shall be through the Owner's Representative, unless otherwise indicated in the Contract Documents.

**1.1.4 Architect**

When the term "Architect" is used herein, it shall refer to the Architect or the Engineer specified and defined in the Contract for Construction or its duly authorized representative. Communications to the Architect shall be forwarded to the address shown in the Contract for Construction.

**1.1.5 Owner's Authorized Agent**

When the term "Owner's Authorized Agent" is used herein, it shall refer to an employee or agency acting on the behalf of the Owner's Representative to perform duties related to code inspections, testing, operational systems check, certification or accreditation inspections, or other specialized work.

**1.1.6 Contractor**

The Contractor is the person or entity with whom the Owner has entered into the Contract for Construction. The term "Contractor" means the Contractor or the Contractor's authorized representative.

**1.1.7 Subcontractor and Lower-tier Subcontractor**

A Subcontractor is a person or organization who has a contract with the Contractor to perform any of the Work. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or its authorized representative. The term "Subcontractor" also is applicable to those furnishing materials to be incorporated in the Work whether

performed at the Owner's site or off site, or both. A lower-tier Subcontractor is a person or organization who has a contract with a Subcontractor or another lower-tier Subcontractor to perform any of the Work at the site. Nothing contained in the Contract Documents shall create contractual relationships between the Owner or the Architect and any Subcontractor or lower-tier Subcontractor of any tier.

**1.1.8 Diversity Definitions**

"Diverse Firm" shall mean an approved, certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more diverse individuals as described below.

**.1 Minority Business Enterprises (MBE)**

Minority Business Enterprise (MBE) shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more minorities as defined below or, in the case of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more minorities as defined below, and whose management and daily business operations are controlled by one (1) or more minorities as defined herein.

**.1.1** "African Americans", which includes persons having origins in any of the black racial groups of Africa.

**.1.2** "Hispanic Americans", which includes persons of Mexican, Puerto Rican, Cuban, Central or South American, or other Spanish culture or origin, regardless of race.

**.1.3** "Native Americans", which includes persons of American Indian, Eskimo, Aleut, or Native Hawaiian origin.

**.1.4** "Asian-Pacific Americans", which includes persons whose origins are from Japan, China, Taiwan, Korea, Vietnam, Laos, Cambodia, the Philippines, Samoa, Guam, the U.S. Trust Territories of the Pacific, or the Northern Marianas.

**.1.5** "Asian-Indian Americans", which includes persons whose origins are from India, Pakistan, or Bangladesh.

**.2 Women Business Enterprise (WBE)**

Women Business Enterprise (WBE) shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more women or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more women, and whose management and daily business operations are controlled by one (1) or more women.

**.3 Veteran Owned Business**

Veteran Owned Business shall mean an approved certified business concern which is at least fifty-one percent (51%) owned and controlled by one (1) or more Veterans or, in the case of any publicly owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Veterans, and whose management and daily business operations are controlled by one (1) or more Veterans. Veterans must be certified by the appropriate federal agency responsible for veterans' affairs.

**.4 Service-Disabled Veteran Enterprise (SDVE)**

Service-Disabled Veteran Enterprise (SDVE) shall mean a business certified by the State of Missouri Office of Administration as a Service-Disabled Veteran Enterprise, which is at least fifty-one percent (51%) owned and controlled by one (1) or more Serviced-Disabled Veterans or, in the case

of any publicly-owned business, in which at least fifty-one percent (51%) of the stock of which is owned by one (1) or more Service-Disabled Veterans, and whose management and daily business operations are controlled by one (1) or more Serviced-Disabled Veterans.

#### **.5 Disadvantaged Business Enterprise (DBE)**

A Disadvantaged Business Enterprise (DBE) is a for-profit small business concern where a socially and economically disadvantaged individual owns at least 51% interest and also controls management and daily business operations. These firms can also be referred to as Small Disadvantaged Businesses (SDB). Eligibility requirements for certification are stated in 49 CFR (Code of Federal Regulations), part 26, Subpart D.

U.S. citizens that are African Americans, Hispanics, Native Americans, Asian-Pacific and Subcontinent Asian Americans, and women are presumed to be socially and economically disadvantaged. Also recognized as DBEs are Historically Black Colleges and Universities (HBCU) and small businesses located in Federal HUB Zones.

To be regarded as economically disadvantaged, an individual must have a personal net worth that does not exceed \$1.32 million. To be seen as a small business, a firm must meet Small Business Administration (SBA) size criteria (500 employees or less) and have average annual gross receipts not to exceed \$22.41 million. To be considered a DBE/SDB, a small business owned and controlled by socially and/or economically disadvantaged individuals must receive DBE certification from one of the recognized Missouri state agencies to be recognized in this classification.

#### **1.1.9 Work**

Work shall mean supervision, labor, equipment, tools, material, supplies, incidentals operations and activities required by the Contract Documents or reasonably inferable by the Contractor therefrom as necessary to produce the results intended by the Contract Documents in a safe, expeditious, orderly, and workmanlike manner, and in the best manner known to each respective trade.

#### **1.1.10 Approved**

The terms “approved”, “equal to”, “directed”, “required”, “ordered”, “designated”, “acceptable”, “compliant”, “satisfactory”, and similar words or phrases will be understood to have reference to action on the part of the Architect and/or the Owner’s Representative.

#### **1.1.11 Contract Documents**

The Contract Documents consist of (1) the executed Contract for Construction, (2) these General Conditions of the Contract for Construction, (3) any Supplemental Conditions or Special Conditions identified in the Contract for Construction, (4) the Specifications identified in the Contract for Construction, (5) the Drawings identified in the Contract for Construction, (6) Addenda issued prior to the receipt of bids, (7) Contractor’s bid addressed to Owner, including Contractor’s completed Qualification

Statement, (8) Contractor’s Performance Bond and Contractor’s Payment Bond, (9) Notice to Proceed, (10) and any other exhibits and/or post bid adjustments identified in the Contract for Construction, (11) Advertisement for Bid, (12) Information for Bidders, and (13) Change Orders issued after execution of the Contract. All other documents and technical reports and information are not Contract Documents, including without limitation, Shop Drawings, and Submittals.

#### **1.1.12 Contract**

The Contract Documents form the Contract and are the exclusive statement of agreement between the parties. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior representations or agreements, either written or oral. The Contract Documents shall not be construed to create a contractual relationship of any kind between the Owner and a Subcontractor or any lower-tier Subcontractor.

#### **1.1.13 Change Order**

The Contract may be amended or modified without invalidating the Contract only by a Change Order, subject to the limitations in Article 7 and elsewhere in the Contract Documents. A Change Order is a written instrument signed by the Owner and the Contractor stating their agreement to a change in the Work, the amount of the adjustment to the Contract Sum, if any, and the extent of the adjustment to the Contract Time, if any. Agreement to any Change Order shall constitute a final settlement of all matters relating to the change in the Work which is the subject of the Change Order, including, but not limited to, all direct and indirect costs associated with such change and any and all adjustments of the Contract Sum, time and schedule.

#### **1.1.14 Substantial Completion**

The terms “Substantial Completion” or “substantially complete” as used herein shall be construed to mean the completion of the entire Work, including all submittals required under the Contract Documents, except minor items which in the opinion of the Architect, and/or the Owner’s Representative will not interfere with the complete and satisfactory use of the facilities for the purposes intended.

#### **1.1.15 Final Completion**

The date when all punch list items are completed, including all closeout submittals and approval by the Architect is given to the Owner in writing.

#### **1.1.16 Supplemental and Special Conditions**

The terms “Supplemental Conditions” or “Special Conditions” shall mean the part of the Contract Documents which amend, supplement, delete from, or add to these General Conditions.

#### **1.1.17 Day**

The term “day” as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

#### **1.1.18 Knowledge**

The terms “knowledge,” “recognize” and “discover” their respective derivatives and similar terms in the Contract Documents, as used in reference to the Contractor, shall be interpreted to mean that which the Contractor knows or should know, recognizes, or should recognize and discovers or should discover in exercising the care, skill, and diligence of a diligent and prudent contractor familiar with the Work. Analogously, the expression “reasonably inferable” and similar terms in the Contract Documents shall be interpreted to mean reasonably inferable by a diligent and prudent contractor familiar with the Work.

#### **1.1.19 Punch List**

“Punch List” means the list of items, prepared in connection with the inspection(s) of the Project by the Owner’s Representative or the Architect in connection with Substantial Completion of the Work or a portion of the Work, which the Owner’s Representative or the Architect has designated as remaining to be performed, completed, or corrected before the Work will be accepted by the Owner.

#### **1.1.20 Force Majeure**

An event or circumstance that could not have been reasonably anticipated and is out of the control of both the Owner and the Contractor.

### **1.2 Specifications and Drawings**

**1.2.1** The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, construction system, standards and workmanship and performance of related services for the Work identified in the Contract for Construction. Specifications are separated into titled divisions for convenience of reference only. Organization of the Specifications into divisions, sections and articles, and arrangement of Drawings shall not control the Contractor in dividing the Work among Subcontractors or in establishing the extent of Work to be performed by any trade. Such separation will not operate to make the Owner or the Architect an arbiter of labor disputes or work agreements.

**1.2.2** The drawings herein referred to, consist of drawings prepared by the Architect, and are enumerated in the Contract Documents.

**1.2.3** Drawings are intended to show general arrangements, design, and dimensions of work and are partly diagrammatic. Dimensions shall not be determined by scale or rule. If figured dimensions are lacking, they shall be supplied by the Architect on the Contractor’s written request to the Owner’s Representative.

**1.2.4** The intent of the Contract Documents is to include all items necessary for the proper execution and completion of the Work by the Contractor. The Contract Documents are complimentary, and what is required by one shall be as binding as if required by all; performance by the Contractor

shall be required only to the extent consistent with the Contract Documents and reasonably inferable from them as being necessary to produce the intended results.

**1.2.5** In the event of inconsistencies within or between parts of the Contract Documents, or between the Contract Documents and applicable standards, codes and ordinances, the Contractor shall (1) provide the better quality or greater quantity of Work or (2) comply with the more stringent requirement; either or both in accordance with the Owner’s Representative’s interpretation. On the Drawings, given dimensions shall take precedence over scaled measurements and large-scale drawings over small scale drawings. Before ordering any materials or doing any Work, the Contractor and each Subcontractor shall verify measurements at the Work site and shall be responsible for the correctness of such measurements. Any difference which may be found shall be submitted to the Owner’s Representative and the Architect for resolution before proceeding with the Work. If a minor change in the Work is found necessary due to actual field conditions, the Contractor shall submit detailed drawings of such departure for the approval by the Owner’s Representative and the Architect before making the change.

**1.2.6** Data in the Contract Documents concerning lot size, ground elevations, present obstructions on or near the site, locations and depths of sewers, conduits, pipes, wires, etc., position of sidewalks, curbs, pavements, etc., and nature of ground and subsurface conditions have been obtained from sources the Architect believes reliable, but the Architect and the Owner do not represent or warrant that this information is accurate or complete. The Contractor shall verify such data to the extent possible through normal construction procedures, including but not limited to contacting utility owners and by prospecting.

**1.2.7** Only work included in the Contract Documents is authorized, and the Contractor shall do no work other than that described therein.

**1.2.8** Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become familiar with local conditions under which the Work is to be performed and correlated personal observations with requirements of the Contract Documents. The Contractor represents that it has performed its own investigation and examination of the Work site and its surroundings and satisfied itself before entering into this Contract as to:

- .1** conditions bearing upon transportation, disposal, handling, and storage of materials;
- .2** the availability of labor, materials, equipment, water, electrical power, utilities and roads;
- .3** uncertainties of weather, river stages, flooding and similar characteristics of the site;
- .4** conditions bearing upon security and protection of material, equipment, and Work in progress;
- .5** the form and nature of the Work site, including the surface and sub-surface conditions;

.6 the extent and nature of Work and materials necessary for the execution of the Work and the remedying of any defects therein; and

.7 the means of access to the site and the accommodations it may require and, in general, shall be deemed to have obtained all information as to risks, contingencies and other circumstances.

.8 the ability to complete work without disruption to normal campus activities, except as specifically allowed in the Contract Documents.

The Owner assumes no responsibility or liability for the physical condition or safety of the Work site, or any improvements located on the Work site. The Contractor shall be solely responsible for providing a safe place for the performance of the Work. The Owner shall not be required to make any adjustment in either the Contract Sum or Contract Time concerning any failure by the Contractor or any Subcontractor to comply with the requirements of this Paragraph.

**1.2.9** Drawings, specifications, and copies thereof furnished by the Owner are and shall remain the Owner's property. They are not to be used on another project and, with the exception of one contract set for each party to the Contract, shall be returned to the Owner's Representative on request, at the completion of the Work.

### **1.3 Required Provisions Deemed Inserted**

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

## **ARTICLE 2 OWNER**

### **2.1 Information and Services Required of Owner**

**2.1.1** Permits and fees are the responsibility of the Contractor under the Contract Documents, unless specifically stated in the Contract Documents that the Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities.

**2.1.2** When requested in writing by the Contractor, information or services under the Owner's control, which are reasonably necessary to perform the Work, will be furnished by the Owner with reasonable promptness to avoid delay in the orderly progress of the Work.

### **2.2 Owner's Right to Stop the Work**

**2.2.1** If the Contractor fails to correct Work which is not in strict accordance with the requirements of the Contract Documents or fails to carry out Work in strict accordance with the Contract Documents, the Owner's Representative may order the Contractor to stop the Work, or any portion thereof, until the cause for such order has been eliminated; however, the right of the Owner to stop the Work will not give rise to a duty on the part of the Owner to exercise this right for the benefit of the Contractor or any other person or entity. The Owner's lifting of Stop Work Order shall not prejudice the Owner's right to enforce any provision of this Contract.

### **2.3 Owner's Right to Carry Out the Work**

**2.3.1** If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a seven (7) day period after receipt of a written notice from the Owner to correct such default or neglect, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. In such case, an appropriate Change Order shall be issued deducting from payments then or thereafter due the Contractor the cost of correcting such deficiencies, including compensation for the Architect's additional services and expenses made necessary by such default or neglect. If payments then or thereafter due the Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to Owner. However, such notice shall be waived in the event of an emergency with the potential for property damage or the endangerment of students, faculty, staff, the public or construction personnel, at the sole discretion of the Owner.

**2.3.2** In the event the Contractor has not satisfactorily completed all items on the Punch List within thirty (30) days of its receipt, the Owner reserves the right to complete the Punch List without further notice to the Contractor or its surety. In such case, the Owner shall be entitled to deduct from payments then or thereafter due the Contractor the cost of completing the Punch List items, including compensation for the Architect's additional services. If payments then or thereafter due Contractor are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner.

### **2.4 Extent of Owner Rights**

**2.4.1** The rights stated in Article 2 and elsewhere in the Contract Documents are cumulative and not in limitation of any rights of the Owner (1) granted in the Contract Documents, (2) at law or (3) in equity.

**2.4.2** In no event shall the Owner have control over, charge of, or any responsibility for construction means, methods, techniques, sequences or procedures or for safety precautions and programs in connection with the Work, notwithstanding any of the rights and authority granted the Owner in the Contract Documents.

## **ARTICLE 3 CONTRACTOR**

### **3.1 Contractor's Warranty**

**3.1.1** The Contractor warrants all equipment and materials furnished, and work performed, under this Contract, against defective materials and workmanship for a period of twelve months after acceptance as provided in this Contract, unless a longer period is specified, regardless of whether the same were furnished or performed by the Contractor or any Subcontractors of any tier. Upon written notice from the Owner of any breach of warranty during the applicable warranty period due to defective material or workmanship, the affected part or parts thereof shall be repaired or replaced by the Contractor at no cost to the Owner. Should the Contractor fail or refuse to make the necessary repairs, replacements, and tests when requested by the Owner, the Owner may perform, or cause the necessary work and tests to be performed, at the Contractor's expense, or exercise the Owner's rights under Article 14.

**3.1.2** Should one or more defects mentioned above appear within the specified period, the Owner shall have the right to continue to use or operate the defective part or apparatus until the Contractor makes repairs or replacements or until such time as it can be taken out of service without loss or inconvenience to the Owner.

**3.1.3** The above warranties are not intended as a limitation but are in addition to all other express warranties set forth in this Contract and such other warranties as are implied by law, custom, and usage of trade. The Contractor, and its surety or sureties, if any, shall be liable for the satisfaction and full performance of the warranties set forth herein.

**3.1.4** Neither the final payment nor any provision in the Contract Documents nor partial or entire occupancy of the premises by the Owner, nor expiration of warranty stated herein, will constitute an acceptance of Work not done in accordance with the Contract Documents or relieve the Contractor of liability in respect to any responsibility for non-conforming work. The Contractor shall immediately remedy any defects in the Work and pay for any damage to other Work resulting therefrom upon written notice from the Owner. Should the Contractor fail or refuse to remedy the non-conforming work, the Owner may perform, or cause to be performed all actions necessary to bring the Work into conformance with the Contract Documents at the Contractor's expense.

**3.1.5** The Contractor agrees to defend, indemnify, and save harmless The Curators of the University of Missouri, their officers, agents, employees, and volunteers, from and against all loss or expense from any injury or damages to property of others suffered or incurred on account of any breach of the aforesaid obligations and covenants. The Contractor agrees to investigate, handle, respond to and provide defense for and defend against any such liability, claims, and demands at the sole expense of the Contractor, or at the option of the University, agrees to pay to or

reimburse the University for the defense costs incurred by the University in connection with any such liability claims, or demands. The parties hereto understand and agree that the University is relying on and does not waive or intend to waive by any provision of this Contract, any monetary limitations or any other rights, immunities, and protections provided by the State of Missouri, as from time to time amended, or otherwise available to the University, or its officers, employees, agents or volunteers.

### **3.2 Compliance with Laws, Regulations, Permits, Codes, and Inspections**

**3.2.1** The Contractor shall, without additional expense to the Owner, comply with all applicable laws, ordinances, rules, permit requirements, codes, statutes, and regulations (which may be collectively referred to as "laws").

**3.2.2** Since the Owner is an instrumentality of the State of Missouri, municipal, or political subdivision, ordinances, zoning ordinances, and other like ordinances are not applicable to construction on the Owner's property, and the Contractor will not be required to submit plans and specifications to any municipal or political subdivision authority to obtain construction permits or any other licenses or permits from or submit to, inspection by any municipality or political subdivision relating to the construction on the Owner's property, unless required by the Owner in these Contract Documents or otherwise in writing.

**3.2.3** All fees, permits, inspections, or licenses required by municipality or political subdivision for operation on property not belonging to the Owner, shall be obtained by and paid for by the Contractor. The Contractor, of its own expense, is responsible to ensure that all inspections required by said permits or licenses on property, easements, or utilities not belonging to the Owner are conducted as required therein. All connection charges, assessments or transportation fees as may be imposed by any utility company or others are included in the Contract Sum and shall be the Contractor's responsibility.

**3.2.4** If the Contractor has knowledge that any Contract Documents are at variance with any laws, including Americans with Disabilities Act – Standards for Accessible Design, ordinances, rules, regulations, or codes applying to the Work, Contractor shall promptly notify the Architect and the Owner's Representative, in writing, and any necessary changes will be adjusted as provided in the Contract Documents. However, it is not the Contractor's primary responsibility to ascertain that the Contract Documents are in accordance with applicable laws, unless such laws bear upon performance of the Work.

### **3.3 Anti-Kickback**

**3.3.1** No member or delegate to Congress, or resident commissioner, shall be admitted to any share or part of this Contract or to any benefit that may arise therefrom, but this provision shall not be construed to extend to this Contract if made with a corporation for its general benefit.

**3.3.2** No official of the Owner who is authorized in such capacity and on behalf of the Owner to negotiate, make, accept or approve, or to take part in negotiating, making, accepting, or approving any architectural, engineering, inspection, construction, or material supply contract or any Subcontract of any tier in connection with the construction of the Work shall have a financial interest in this Contract or in any part thereof, any material supply contract, Subcontract of any tier, insurance contract, or any other contract pertaining to the Work.

### **3.4 Supervision and Construction Procedures**

**3.4.1** The Contractor shall supervise and direct the Work, using the Contractor's best skill and attention. The Contractor shall be solely responsible for and have control over construction means, methods, techniques, sequences, and procedures and for coordinating all portions of the Work under the Contract. The Contractor shall supply sufficient and competent supervision and personnel, and sufficient material, plant, and equipment to prosecute the Work with diligence to ensure completion thereof within the time specified in the Contract Documents, and shall pay when due any laborer, Subcontractor of any tier, or supplier.

**3.4.2** The Contractor, if an individual, shall give the Work an adequate amount of personal supervision, and if a partnership, corporation, or joint venture or other business entity, the Work shall be given an adequate amount of personal supervision by a partner or executive officer, as determined by the Owner's Representative.

**3.4.3** The Contractor and each of its Subcontractors of any tier shall submit to the Owner such schedules of quantities and costs, progress schedules in accordance with 3.18 this document, payrolls, reports, estimates, records, and other data as the Owner may request concerning Work performed or to be performed under the Contract.

**3.4.4** The Contractor shall be represented at the site by a competent superintendent from the beginning of the Work until its final acceptance, whenever Contract Work is being performed, unless otherwise permitted in writing by the Owner's Representative. The superintendent for the Contractor shall exercise general supervision over the Work and such superintendent shall have decision making authority of the Contractor. Communications given to the superintendent shall be binding as if given to the Contractor. The superintendent shall not be changed by the Contractor without approval from the Owner's Representative.

**3.4.5** The Contractor shall establish and maintain a permanent benchmark to which access may be had during progress of the Work, and Contractor shall establish all lines and levels, and shall be responsible for the correctness of such. The Contractor shall be fully responsible for all layout work for the proper location of Work in strict accordance with the Contract Documents.

**3.4.6** The Contractor shall establish and be responsible for wall and partition locations. If applicable, separate contractors shall be entitled to rely upon these locations and for setting their sleeves, openings, or chases.

**3.4.7** The Contractor's scheduled outage/tie-in plan, time, and date for any utilities is subject to approval by the Owner's Representative. Communication with the appropriate entity and planning for any scheduled outage/tie-in of utilities shall be the responsibility of the Contractor. Failure of the Contractor to comply with the provisions of this Paragraph shall cause the Contractor to forfeit any right to an adjustment of the Contract Sum or Contract Time for any postponement, rescheduling or other delays ordered by the Owner in connection with such Work. The Contractor shall follow the following procedures for all utility outages/tie-ins or disruption of any building system:

- .1** All shutting of valves, switches, etc., shall be by the Owner's personnel.
- .2** The Contractor shall submit its preliminary outage/tie-in schedule with its baseline schedule.
- .3** The Contractor shall request an outage/tie-in meeting at least two weeks before the outage/tie-in is required.
- .4** The Owner's Representative will schedule an outage/tie-in meeting at least one week prior to the outage/tie-in.

**3.4.8** The Contractor shall coordinate all Work so there shall be no prolonged interruption of existing utilities, systems, and equipment of the Owner. Any existing plumbing, heating, ventilating, air conditioning, or electrical disconnection necessary, which affect portions of this construction or building or any other building, must be scheduled with the Owner's Representative to avoid any disruption of operation within the building under construction or other buildings or utilities. In no case shall utilities be left disconnected at the end of a workday or over a weekend. Any interruption of utilities, either intentionally or accidentally, shall not relieve the Contractor from repairing and restoring the utility to normal service. Repairs and restoration shall be made before the workers responsible for the repair and restoration leave the job.

**3.4.9** The Contractor shall be responsible for repair of damage to property on or off the project occurring during construction of project, and all such repairs shall be made to meet code requirements or to the satisfaction of the Owner's Representative if code is not applicable.

**3.4.10** The Contractor shall be responsible for all shoring required to protect the Work or adjacent property and shall pay

for any damage caused by failure to shore or by improper shoring or by failure to give proper notice. Shoring shall be removed only after completion of permanent supports.

**3.4.11** The Contractor shall maintain at the Contractor's own cost and expense, adequate, safe and sufficient walkways, platforms, scaffolds, ladders, hoists and all necessary, proper, and adequate equipment, apparatus, and appliances useful in carrying on the Work and which are necessary to make the place of Work safe and free from avoidable danger for students, faculty, staff, the public and construction personnel, and as may be required by safety provisions of applicable laws, ordinances, rules regulations and building and construction codes.

**3.4.12** During the performance of the Work, the Contractor shall be responsible for providing and maintaining warning signs, lights, signal devices, barricades, guard rails, fences, and other devices appropriately located on site which shall give proper and understandable warning to all persons of danger of entry onto land, structure, or equipment, within the limits of the Contractor's work area.

**3.4.13** The Contractor shall pump, bail, or otherwise keep any general excavations free of water. The Contractor shall keep all areas free of water before, during and after concrete placement. The Contractor shall be responsible for protection, including weather protection, and proper maintenance of all equipment and materials installed, or to be installed by the Contractor.

**3.4.14** The Contractor shall be responsible for care of the Work and must protect same from damage of defacement until acceptance by the Owner. All damaged or defaced Work shall be repaired or replaced to the Owner's satisfaction, without cost to the Owner.

**3.4.15** When requested by the Owner's Representative, the Contractor, at no extra charge, shall provide scaffolds or ladders in place as may be required by the Architect or the Owner for examination or inspection of Work in progress or completed.

**3.4.16** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors of any tier and their agents and employees, and any other entity or persons performing portions of the Work.

**3.4.17** The Contractor shall not be relieved of its obligations to perform the Work in accordance with the Contract Documents either by activities or duties of the Owner's Representative or the Architect in their administration of the Contract, or by tests, inspections or approvals required or performed by persons other than the Contractor.

**3.4.18** The Contractor shall be responsible for inspection of portions of the Work already performed under this Contract to determine that such portions are compliant and in proper condition to receive subsequent Work.

### **3.5 Use of Site**

**3.5.1** The Contractor shall limit operations and storage of material to the area within the Work limit lines shown on Drawings, except as necessary to connect to exiting utilities, shall not encroach on neighboring property, and shall exercise caution to prevent damage to existing structures.

**3.5.2** Only materials and equipment, which are to be used directly in the Work, shall be brought to and stored on the Work site by the Contractor. After equipment is no longer required for the Work, it shall be promptly removed from the Work site. Protection of construction materials and equipment stored at the Work site from weather, theft, damage and all other adversity is solely the responsibility of the Contractor.

**3.5.3** No project signs shall be erected without the written approval of the Owner's Representative.

**3.5.4** The Contractor shall ensure that the Work is at all times performed in a manner that affords reasonable access, both vehicular and pedestrian, to the site of the Work and all adjacent areas. Particular attention shall be paid to access for emergency vehicles, including fire trucks. Wherever there is the possibility of interfering with normal emergency vehicle operations, the Contractor shall obtain permission from both campus and municipal emergency response entities prior to limiting any access. The Work shall be performed, to the fullest extent reasonably possible, in such a manner that public areas adjacent to the site of the Work shall be free from all debris, building materials and equipment likely to cause hazardous conditions. Without limitation of any other provision of the Contract Documents, the Contractor shall not interfere with the occupancy or beneficial use of (1) any areas and buildings adjacent to the site of the Work or (2) the Work in the event of partial occupancy. The Contractor shall assume full responsibility for any damage to the property comprising the Work or to the owner or occupant of any adjacent land or areas resulting from the performance of the Work.

**3.5.5** The Contractor shall not permit any workers to use any existing facilities at the Work site, including, without limitation, lavatories, toilets, entrances, and parking areas other than those designated by Owner. The Contractor, Subcontractors of any tier, suppliers and employees shall comply with instructions or regulations of the Owner's Representative governing access to, operation of, and conduct while in or on the premises and shall perform all Work required under the Contract Documents in such a manner as not to unreasonably interrupt or interfere with the conduct of the Owner's operations. Any request for Work, a suspension of Work or any other request or directive received by the Contractor from occupants of existing buildings shall be referred to the Owner's Representative for determination.



**3.5.6** The Contractor and the Subcontractor of any tier shall have its' name, acceptable abbreviation or recognizable logo and the name of the city and state of the mailing address of the principal office of the company, on each motor vehicle and motorized self-propelled piece of equipment which is used in connection with the project. The signs are required on such vehicles during the time the Contractor is working on the project.

### **3.6 Review of Contract Documents and Field Conditions by Contractor**

**3.6.1** The Contractor shall carefully study and compare the Contract Documents with each other and with information furnished by the Architect and the Owner and shall at once report in writing to the Architect and the Owner's Representative any errors, inconsistencies or omissions discovered. If the Contractor performs any construction activity which it knows or should have known involves a recognized error, inconsistency, or omission in the Contract Documents without such written notice to the Architect and the Owner's Representative, the Contractor shall assume appropriate responsibility for such performance and shall bear an appropriate amount of the attributable costs for correction.

**3.6.2** The Contractor shall take field measurements and verify field conditions and shall carefully compare such field measurements and conditions and other information known to the Contractor with the Contract Documents before commencing activities. Errors, inconsistencies, or omissions discovered shall be reported in writing to the Architect and the Owner's Representative within twenty-four (24) hours. During the progress of the Work, the Contractor shall verify all field measurements prior to fabrication of building components or equipment and proceed with the fabrication to meet field conditions. The Contractor shall consult all Contract Documents to determine the exact location of all work and verify spatial relationships of all work. Any question concerning said location or spatial relationships shall be submitted to the Owner's Representative. Specific locations for equipment, pipelines, ductwork and other such items of work, where not dimensioned on plans, shall be determined in consultation with the Owner's Representative and the Architect. The Contractor shall be responsible for the proper fitting of the Work in place.

**3.6.3** The Contractor shall provide, at the proper time, such material as required for support of the Work. If openings or chases are required, whether shown on Drawings or not, the Contractor shall see they are properly constructed. If required openings or chases are omitted, the Contractor shall cut them at the Contractors own expense, but only as directed by the Architect, through the Owner's Representative.

**3.6.4** Should the Contract Documents fail to particularly describe materials or goods to be used, it shall be the duty of the Contractor to inquire of the Architect and

the Owner's Representative what is to be used and to supply it at the Contractor's expense, or else thereafter replace it to the Owner's Representative's satisfaction. At a minimum, the Contractor shall provide the quality of materials as generally specified throughout the Contract Documents.

### **3.7 Cleaning and Removal**

**3.7.1** The Contractor shall keep the Work site and surrounding areas free from accumulation of waste materials, rubbish, debris, and dirt resulting from the Work and shall clean the Work site and surrounding areas as requested by the Architect and the Owner's Representative, including mowing of grass greater than six (6) inches high. The Contractor shall be responsible for the cost of clean up and removal of debris from premises. The building and premises shall be kept clean, safe, in a workmanlike manner, and in compliance with OSHA standards and code at all times. At completion of the Work, the Contractor shall remove from and about the Work site tools, construction equipment, machinery, fencing, and surplus materials. Further, at the completion of the Work, all dirt, stains, and smudges shall be removed from every part of the building, all glass in doors and windows shall be washed, and entire Work shall be left broom clean in a finished state ready for occupancy. The Contractor shall advise his Subcontractors of any tier of this provision, and the Contractor shall be fully responsible for leaving the premises in a finished state ready for use to the satisfaction of the Owner's Representative. If the Contractor fails to comply with the provisions of this Paragraph, the Owner may do so, and the cost thereof shall be charged to the Contractor.

### **3.8 Cutting and Patching**

**3.8.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly.

**3.8.2** The Contractor shall not damage or endanger a portion of the Work or fully or partially completed construction of the Owner or separate contractors by cutting, patching, or otherwise altering such construction, or by excavation. The Contractor shall not cut or otherwise alter such construction by the Owner or a separate contractor except with written consent of the Owner and of such separate contractor; such consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold from the Owner or a separate contractor the Contractor's consent to cutting or otherwise altering the Work.

**3.8.3** If the Work involves renovation and/or alteration of existing improvements, the Contractor acknowledges that cutting and patching of the Work is essential for the Work to be successfully completed. The Contractor shall perform any cutting, altering, patching, and/or fitting of the Work necessary for the Work and the existing improvements to be fully integrated and to present the visual appearance of an entire, completed, and unified project. In performing any Work which requires cutting or patching, the Contractor shall use its best efforts to protect and preserve the visual appearance and

aesthetics of the Work to the reasonable satisfaction of both the Owner's Representative and the Architect.

### **3.9 Indemnification**

**3.9.1** To the fullest extent permitted by law, the Contractor shall defend, indemnify, and hold harmless the Owner, the Architect, the Architect's consultants, and the agents, employees, representatives, insurers and re-insurers of any of the foregoing (hereafter collectively referred to as the "Indemnitees") from and against claims, damages (including loss of use of the Work itself), punitive damages, penalties and civil fines unless expressly prohibited by law, losses and expenses, including, but not limited to, attorneys' fees, arising out of or resulting from performance of the Work to the extent caused in whole or in part by negligent acts or omissions or other fault of the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by them or anyone for whose acts they may be liable, regardless of whether or not such claim, damage, loss, or expense is caused in part by the negligent acts or omissions or other fault of a party indemnified hereunder. The Contractor's obligations hereunder are in addition to and shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that the Owner may possess. If one or more of the Indemnitees demand performance by the Contractor of obligations under this Paragraph or other provisions of the Contract Documents and if the Contractor refuses to assume or perform, or delays in assuming or performing the Contractor's obligations, Contractor shall pay each Indemnitee who has made such demand its respective attorneys' fees, costs, and other expenses incurred in enforcing this provision. The defense and indemnity required herein shall be a binding obligation upon the Contractor whether or not an Indemnitee has made such demand. Even if a defense is successful to a claim or demand for which the Contractor is obligated to indemnify the Indemnitees from under this Paragraph, the Contractor shall remain liable for all costs of defense.

**3.9.2** The indemnity obligations of the Contractor under this Section 3.9 shall survive termination of this Contract or final payment thereunder. In the event of any claim or demand made against any party which is entitled to be indemnified hereunder, the Owner may in its sole discretion reserve, return or apply any monies due or to become due the Contractor under the Contract for the purpose of resolving such claims; provided, however, that the Owner may release such funds if the Contractor provides the Owner with reasonable assurance of protection of the Owner's interests. The Owner shall in its sole discretion determine if such assurances are reasonable. The Owner reserves the right to control the defense and settlement of any claim, action or proceeding which the Contractor has an obligation to indemnify the Indemnitees against.

**3.9.3** In claims against any person or entity indemnified under this Section 3.9 by an employee of the Contractor, a

Subcontractor of any tier, anyone directly or indirectly employed by them or anyone for whose acts they may be liable, the indemnification obligation under this Section 3.9 shall not be limited by a limitation on amount or type of damages, compensation or benefits payable by or for the Contractor or a Subcontractor of any tier under workers' or workmen's compensation acts, disability benefit acts or other employee benefit acts.

**3.9.4** The obligations of the Contractor under Paragraph 3.9.1 shall not extend to the liability of the Architect, the Architect's agents or employees, arising out of the preparation and approval of maps, drawings, opinions, reports, surveys, Change Orders, designs, or Specifications.

### **3.10 Patents**

**3.10.1** The Contractor shall hold and save harmless the Owner and its officers, agents, servants, and employees from liability of any nature or kind, including cost and expense, for, or on account of, any patented or otherwise protected invention, process, article, or appliance manufactured or used in the performance of the Contract, including its use by the Owner, unless otherwise specifically stipulated in the Contract Documents.

**3.10.2** If the Contractor uses any design, device, or material covered by letters patent or copyright, the Contractor shall provide for such use by suitable agreement with the Owner of such patented or copyrighted design, device, or material. It is mutually agreed and understood, without exception, that the Contract Sum include, and the Contractor shall pay all royalties, license fees or costs arising from the use of such design, device, or material in any way involved in the Work. The Contractor and/or sureties shall indemnify and save harmless the Owner from any and all claims for infringement by reason of the use of such patented or copyrighted design, device, or material or any trademark or copyright in connection with Work agreed to be performed under this Contract and shall indemnify the Owner for any cost, expense, or damage it may be obligated to pay by reason of such infringement at any time during the prosecution of the Work or after completion of the Work.

### **3.11 Delegated Design**

**3.11.1** If the Contract Documents specify the Contractor is responsible for the design of any Work as part of the project, then the Contractor shall procure all design services and certifications necessary to complete the Work as specified, from a design professional licensed in the State of Missouri. The signature and seal of that design professional shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals related to the Work. The design professional shall maintain insurance as required per Article 11.

### **3.12 Materials, Labor, and Workmanship**

**3.12.1** Materials and equipment incorporated into the Work shall strictly conform to the Contract Documents and representations and approved Samples provided by Contractor

and shall be of the most suitable grade of their respective kinds for their respective uses and shall be fit and sufficient for the purpose intended, merchantable, of good new material and workmanship, and free from defect. Workmanship shall be in accordance with the highest standard in the industry and free from defect in strict accordance with the Contract Documents.

**3.12.2** Materials and fixtures shall be new and of latest design unless otherwise specified and shall provide the most efficient operating and maintenance costs to the Owner. All Work shall be performed by competent workers and shall be of best quality.

**3.12.3** The Contractor shall carefully examine the Contract Documents and shall be responsible for the proper fitting of his material, equipment, and apparatus into the building.

**3.12.4** The Contractor shall base its bid only on the Contract Documents.

**3.12.5** Materials and workmanship shall be subject to inspection, examination, and testing by the Architect and the Owner's Representative at any and all times during manufacture, installation, and construction of any of them, at places where such manufacture, installation, or construction is performed.

**3.12.6** The Contractor shall enforce strict discipline and good order among the Contractor's employees and other persons carrying out the Contract. The Contractor shall not permit employment of unfit persons or persons not skilled in tasks assigned to them.

**3.12.7** Unless otherwise specifically noted, the Contractor shall provide and pay for supervision, labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the Work.

### **3.12.8 Substitutions**

**3.12.8.1** A substitution is a Contractor proposal of an alternate product or method in lieu of what has been specified or shown in the Contract Documents, which is not an "or equal" as set forth in Section 3.13.

**3.12.8.2** The Contractor may make a proposal to the Architect and the Owner's Representative to use substitute products or methods as set forth herein, but the Architect's and the Owner's Representative's decision concerning acceptance of a substitute shall be final. The Contractor must do so in writing and setting forth the following:

**.1** Full explanation of the proposed substitution and submittal of all supporting data including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and other

like information necessary for a complete evaluation of the substitution.

**.2** Reasons the substitution is advantageous and necessary, including the benefits to the Owner and the Work in the event the substitution is acceptable.

**.3** The adjustment, if any, in the Contract Sum, in the event the substitution is acceptable.

**.4** The adjustment, if any, in the time of completion of the Contract and the construction schedule in the event the substitution is acceptable.

**.5** An affidavit stating that (a) the proposed substitution conforms to and meets all of the Contract Document requirements and is code compliant, except as specifically disclosed and set forth in the affidavit and (b) the Contractor accepts the warranty and correction obligations in connection with the proposed substitution as if originally specified by the Architect. Proposals for substitutions shall be submitted to the Architect and the Owner's Representative in sufficient time to allow the Architect and the Owner's Representative no less than ten (10) working days for review. No substitution will be considered or allowed without the Contractor's submittal of complete substantiating data and information as stated herein.

**3.12.8.3** Substitutions may be rejected without explanation at the Owner's sole discretion and will be considered only under one or more of the following conditions:

**.1** Required for compliance with interpretation of code requirements or insurance regulations then existing;

**.2** Unavailability of specified products, through no fault of the Contractor;

**.3** Material delivered fails to comply with the Contract Documents;

**.4** Subsequent information discloses inability of specified products to perform properly or to fit in designated space;

**.5** Manufacturer/fabricator refuses to certify or guarantee performance of specified product as required; or

**.6** When in the judgment of the Owner or the Architect, a substitution would be substantially to the Owner's best interests, in terms of cost, time, or other considerations.

**3.12.8.4** Whether or not any proposed substitution is accepted by the Owner or the Architect, the Contractor shall reimburse the Owner for any fees charged by the Architect or other consultants for evaluating each proposed substitution.

### **3.13 Approved Equal**

**3.13.1** Whenever in the Contract Documents any article, appliance, device, or material is designated by the name of a manufacturer, vendor, or by any proprietary or trade name, the words "or approved equal," shall automatically follow and shall be implied unless specifically indicated otherwise. The standard products of manufacturers other than those specified will be accepted when, prior to the ordering or use thereof, it is proven to the satisfaction of the Owner's Representative and the Architect they are equal in design, appearance, spare parts availability, strength, durability, usefulness, serviceability, operation cost, maintenance cost, and convenience for the purpose intended. Any general listings of approved

manufacturers in any Contract Document shall be for informational purposes only and it shall be the Contractor's sole responsibility to ensure that any proposed "or equal" complies with the requirements of the Contract Documents and is code compliant.

**3.13.2** The Contractor shall submit to the Architect and the Owner's Representative a written and full description of the proposed "or equal" including all supporting data, including technical information, catalog cuts, warranties, test results, installation instructions, operating procedures, and similar information demonstrating that the proposed "or equal" strictly complies with the Contract Documents. The Architect or the Owner's Representative shall take appropriate action with respect to the submission of a proposed "or equal" item. If Contractor fails to submit proposed "or equals" as set forth herein, it shall waive any right to supply such items. The Contract Sum and Contract Time shall not be adjusted as a result of any failure by Contractor to submit proposed "or equals" as provided for herein. All documents submitted in connection with preparing an "or equal" shall be clearly and obviously marked as a proposed "or equal" submission.

**3.13.3** No approvals or action taken by the Architect or Owner's Representative shall relieve the Contractor from its obligation to ensure that an "or equal" article, appliance, devise, or material strictly complies with the requirements of the Contract Documents. The Contractor shall not propose "or equal" items in connection with Shop Drawings or other Submittals, and the Contractor acknowledges and agrees that no approvals or action taken by the Architect or Owner's Representative with respect to Shop Drawings or other Submittals shall constitute approval of any "or equal" item or relieve the Contractor from its sole and exclusive responsibility. Any changes required in the details and dimensions indicated in the Contract Documents for the incorporation or installation of any "or equal" item supplied by the Contractor shall be properly made and approved by the Architect at the expense of the Contractor. No "or equal" items will be permitted for components of or extensions to existing systems when, in the opinion of the Architect, the named manufacturer must be provided in order to ensure compatibility with the existing systems, including, but not limited to, mechanical systems, electrical systems, fire alarms, smoke detectors, etc. No action will be taken by the Architect with respect to proposed "or equal" items prior to receipt of bids, unless otherwise noted in the Special Conditions.

### **3.14 Shop Drawings, Product Data, Samples, and Coordination Drawings/BIM Models**

**3.14.1** Shop Drawings are drawings, diagrams, schedules, and other data specifically prepared for the Work by the Contractor or a Subcontractor, sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

**3.14.2** Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams, and other information furnished by the Contractor to illustrate materials or equipment for some portion of the Work.

**3.14.3** Samples are physical samples which illustrate materials, equipment or workmanship and establish standards by which the Work will be judged.

**3.14.4** Coordination Drawings are drawings for the integration of the Work, including work first shown in detail on Shop Drawings or product data. Coordination Drawings show sequencing and relationship of separate units of work which must interface in a restricted manner to fit in the space provided, or function as indicated. Coordination Drawings are the responsibility of the Contractor and are submitted for informational purposes. The Special Conditions will state whether Coordination Drawings are required. BIM models may be used for coordination in lieu of Coordination Drawings at the Contractor's discretion, unless required in the Special Conditions. The final Coordination Drawings/BIM Model will not change the Contract Documents, unless approved by a fully executed Change Order describing the specific modifications that are being made to the Contract Documents.

**3.14.5** Shop Drawings, Coordination Drawings/BIM Models, Product Data, Samples, and similar submittals (collectively referred to as "Submittals") are not Contract Documents. The purpose of their submittal is to demonstrate for those portions of the Work for which submittals are required the way the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents.

**3.14.6** The Contractor shall schedule submittal of Shop Drawings and Product Data to the Architect so that no delays will result in delivery of materials and equipment, advising the Architect of priority for checking of Shop Drawings and Product Data, but a minimum of two weeks shall be provided for this purpose. Because time is of the essence in this Contract, unless noted otherwise in the Special Conditions or Technical Specifications, all Submittals, Shop Drawings and Samples must be submitted as required to maintain the Contractor's plan for proceeding but must be submitted within ninety (90) days of the Notice to Proceed. If the Contractor believes that this milestone is unreasonable for any submittal, the Contractor shall request an extension of this milestone, within sixty (60) days of Notice to Proceed, for each submittal that cannot meet the milestone. The request shall contain a reasonable explanation as to why the ninety (90)-day milestone is unrealistic and shall specify a date on which the submittal will be provided, for approval by the Owner's Representative. Failure of the Contractor to comply with this Section may result in delays in the submittal approval process and/or charges for expediting approval, both of which will be the responsibility of the Contractor.

**3.14.7** The Contractor, at its own expense, shall submit Samples required by the Contract Documents with reasonable promptness as to cause no delay in the Work or the activities of

separate contractors and no later than twenty (20) days before materials are required to be ordered for scheduled delivery to the Work site. Samples shall be labeled to designate material or products represented, grade, place of origin, name of producer, name of the Contractor and the name and number of the Owner's project. Quantities of Samples shall be twice the number required for testing so that the Architect can return one set of the Samples. Materials delivered before receipt of Architect's approval may be rejected by the Architect and in such event, the Contractor shall immediately remove all such materials from the Work site. When requested by the Architect or the Owner's Representative, Samples of finished masonry and field applied paints and finishes shall be located as directed and shall include sample panels built at the site of approximately twenty (20) square feet each.

**3.14.8** The Contractor shall perform no portion of the Work requiring submittal and review of Shop Drawings, Product Data, Samples, or similar submittals until the respective submittal has been approved by the Architect. Such Work shall be in accordance with approved Submittals.

**3.14.9** By approving and submitting Shop Drawings, Product Data, Samples and similar submittals, the Contractor represents such Submittals strictly comply with the requirements of the Contract Documents and that the Contractor has determined and verified field measurements and field construction criteria related thereto, that materials are fit for their intended use and that the fabrication, shipping, handling, storage, assembly and installation of all materials, systems and equipment are in accordance with best practices in the industry and are in strict compliance with any applicable requirements of the Contract Documents. The Contractor shall also coordinate each Submittal with other Submittals.

**3.14.10** The Contractor shall be responsible for the correctness and accuracy of the dimensions, measurements and other information contained in the Submittals.

**3.14.11** Each Submittal will bear a stamp or specific indication that the Submittal complies with the Contract Documents and the Contractor has satisfied its obligations under the Contract Documents with respect to the Contractor's review and approval of that Submittal. Each Submittal shall bear the signature of the representative of the Contractor who approved the Submittal, together with the Contractor's name, Owner's name, number of the Project, and the item name and specification section number.

**3.14.12** The Contractor shall not be relieved of responsibility for deviations from requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals. The Contractor shall not be relieved of responsibility for errors or omissions in Shop Drawings, Product Data, Samples, or similar submittals by the Architect's approval thereof. Specifically, but not by way of limitation, the

Contractor acknowledges that the Architect's approval of Shop Drawings shall not relieve the Contractor for responsibility for errors and omissions in the Shop Drawings since the Contractor is responsible for the correctness of dimensions, details and the design of adequate connections and details contained in the Shop Drawings.

**3.14.13** The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data, Samples or similar submittals, to revisions other than those requested by the Architect on previous Submittals.

**3.14.14** The Contractor represents and warrants that all Shop Drawings shall be prepared by persons and entities possessing expertise and experience in the trade for which the Shop Drawing is prepared and, if required by the Architect or applicable laws, by a licensed engineer or other design professional.

### **3.15 Record Drawings**

**3.15.1** The Contractor shall maintain a set of Record Drawings on site in good condition and shall use colored pencils to mark up said set with "record information" in a legible manner to show: (1) bidding addendums, (2) executed Change Orders, (3) deviations from the Drawings made during construction; (4) details in the Work not previously shown; (5) changes to existing conditions or existing conditions found to differ from those shown on any existing drawings; (6) the actual installed position of equipment, piping, conduits, light switches, electric fixtures, circuiting, ducts, dampers, access panels, control valves, drains, openings, and stub-outs; and (7) such other information as either the Owner or the Architect may reasonably request. The prints for Record Drawing use will be a set of "blue line" prints provided by the Architect to the Contractor at the start of construction. Upon Substantial Completion of the Work, the Contractor shall deliver all Record Drawings to the Owner and the Architect for approval. If not approved, the Contractor shall make the revisions requested by the Architect or the Owner's Representative. Final payment and any retainage shall not be due and owing to the Contractor until the final Record Drawings marked by the Contractor as required above are delivered to the Owner.

### **3.16 Operating Instructions and Service Manuals**

**3.16.1** The Contractor shall submit four (4) volumes of operating instructions and service manuals to the Architect before completing 50% of the adjusted contract amount. Payments beyond 50% of the adjusted contract amount may be withheld until all operating instructions and service manuals are received. The operating instructions and service manuals shall contain:

**.1** Start-up and Shutdown Procedures: Provide a step-by-step write up of all major equipment. When manufacturer's printed start-up, trouble shooting and shut-down procedures are available, they may be incorporated into the operating manual for reference.

**.2** Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.

.3 Equipment List: List of all major equipment as installed shall include model number, capacities, flow rate, and name-plate data.

.4 Service Instructions: The Contractor shall be required to provide the following information for all pieces of equipment.

.4.1 Recommended spare parts including catalog number and name of local suppliers or factory representative.

.4.2 Belt sizes, types, and lengths.

.4.3 Wiring diagrams.

.5 Manufacturer's Certificate of Warranty: Manufacturer's certificates of warranty shall be obtained for all major equipment. Warranty shall be obtained for at least one year from the date of Substantial Completion. Where longer period is required by the Contract Documents, the longer period shall govern.

.6 Parts catalogs: For each piece of equipment furnished, a parts catalog or similar document shall be provided which identifies the components by number for replacement ordering.

### **3.16.2 Submission**

.1 Manuals shall be bound into volumes of standard 8 1/2" x 11" hard binders. Large drawings too bulky to be folded into 8 1/2" x 11" shall be separately bound or folded and in brown envelopes, cross-referenced and indexed with the manuals.

.2 The manuals shall identify the Owner's project name, project number, and include the name and address of the Contractor and major Subcontractors of any tier who were involved with the activity described in that particular manual.

### **3.17 Taxes**

**3.17.1** The Contractor shall pay all applicable sales, consumer, use, and similar taxes for the Work which are legally enacted when the bids are received, whether or not yet effective or scheduled to go into effect. However, certain purchases by the Contractor of materials incorporated in or consumed in the Work are exempt from certain sales tax pursuant to Section 144.062, RSMo. The Contractor shall be issued a Project Tax Exemption Certificate for this Work to obtain the benefits of Section 144.062, RSMo.

**3.17.2** The Contractor shall furnish this certificate to all Subcontractors, and any person or entity purchasing materials for the Work shall present such certificate to all material suppliers as authorization to purchase, on behalf of the Owner, all tangible personal property and materials to be incorporated into or consumed in the Work and no other on a tax-exempt basis. Such suppliers shall provide to the purchasing party invoices bearing the name of the exempt entity and the project identification number. Nothing in this Section shall be deemed to exempt from any sales or similar tax the purchase of any construction machinery, equipment or tools used in construction, repairing or remodeling facilities for the Owner. All

invoices for all personal property and materials purchased under a Project Tax Exemption Certificate shall be retained by the Contractor for a period of five years and shall be subject to audit by the Director of Revenue.

**3.17.3** Any excess resalable tangible personal property or materials which were purchased for the project under this Project Tax Exemption Certificate but which were not incorporated into or consumed in the Work shall either be returned to the supplier for credit or the appropriate sales or use tax on such excess property or materials shall be reported on a return and paid by such purchasing party not later than the due date of the purchasing party's Missouri sales or use tax return following the month in which it was determined that the materials were not used in the Work.

**3.17.4** If it is determined that sales tax is owed by the Contractor on property and materials due to the failure of the Owner to revise the certificate expiration date to cover the applicable date of purchase, the Owner shall be liable for the tax owed.

**3.17.5** The Owner shall not be responsible for any tax liability due to the Contractor's neglect to make timely orders, payments, etc. or the Contractor's misuse of the Project Tax Exemption Certificate. The Contractor represents that the Project Tax Exemption Certificate shall be used in accordance with Section 144.062, RSMo and the terms of the Project Tax Exemption Certificate. The Contractor shall indemnify the Owner for any loss or expense, including but not limited to, reasonable attorneys' fees, arising out of the Contractor's use of the Project Tax Exemption Certificate.

### **3.18 Contractor's Construction Schedules**

**3.18.1** The Contractor, within fifteen (15) days after the issuance of the Notice to Proceed, shall prepare and submit for the Owner's and the Architect's information the Contractor's construction schedule for the Work and shall set forth interim dates for completion of various components of the Work and Work Milestone Dates as defined herein. The schedule shall not exceed time limits current under the Contract Documents, shall be revised on a monthly basis or as requested by the Owner's Representative as required by the conditions of the Work, and shall provide for expeditious and practicable execution of the Work. The Contractor shall conform to the most recent schedule.

**3.18.2** The construction schedule shall be in a detailed format satisfactory to the Owner's Representative and the Architect and in accordance with the detailed schedule requirements set forth in this document and the Special Conditions. If the Owner's Representative or the Architect has a reasonable objection to the schedule submitted by Contractor, the construction schedule shall be promptly revised by the Contractor. The Contractor shall monitor the progress of the Work for conformance with the requirements of the construction schedule and shall promptly advise the Owner of any delays or potential delays.

**3.18.3** As time is of the essence to this Contract, the University expects that the Contractor will take all necessary steps to ensure that the project construction schedule shall be prepared in accordance with the specific requirements of the Special Conditions to this Contract. At a minimum, the Contractor shall comply with the following:

- .1 The schedule shall be prepared using Primavera P3, Oracle P6, Microsoft Project or other software acceptable to the Owner's Representative.
- .2 The schedule shall be prepared and maintained in CPM format, in accordance with Construction CPM Scheduling, published by the Associated General Contractors of American (AGC).
- .3 Prior to submittal to the Owner's Representative for review, the Contractor shall obtain full buy-in to the schedule from all major Subcontractors, in writing if so, requested by Owner's Representative.
- .4 Schedule shall be updated, in accordance with Construction CPM Scheduling, published by the AGC, on a monthly basis at minimum, prior to, and submitted with, the monthly pay application or as requested by the Owner's Representative.
- .5 Along with the update the Contractor shall submit a narrative report addressing all changes, delays and impacts, including weather to the schedule during the last month, and explain how the end date has been impacted by same.
- .6 The submission of the updated schedule certifies that all delays and impacts that have occurred on or to the project during the previous month have been factored into the update and are fully integrated into the schedule and the projected completion date.

Failure to comply with any of these requirements will be considered a material breach of this Contract. See Special Conditions for detailed scheduling requirements.

**3.18.4** In the event the Owner's Representative or the Architect determines that the performance of the Work, as of a Milestone Date, has not progressed or reached the level of completion required by the Contract Documents, the Owner shall have the right to order the Contractor to take corrective measures necessary to expedite the progress of construction, including, without limitation, (1) working additional shifts or overtime, (2) supplying additional manpower, equipment, facilities, (3) expediting delivery of materials, and (4) other similar measures (hereinafter referred to collectively as "Extraordinary Measures"). Such Extraordinary Measures shall continue until the progress of the Work complies with the stage of completion required by the Contract Documents. The Owner's right to require Extraordinary Measures is solely for the purpose of ensuring the Contractor's compliance with the construction schedule. The Contractor shall not be entitled to an adjustment in the Contract Sum concerning Extraordinary Measures required by the Owner under or pursuant to this Paragraph. The Owner may exercise the rights furnished the Owner under or pursuant to this Paragraph as frequently as the Owner deems necessary to ensure that the Contractor's performance of the Work will

comply with any Milestone Date or completion date set forth in the Contract Documents.

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

### **4.1 Rights of the Owner**

**4.1.1** The Owner's Representative will administer the Construction Contract. The Architect will assist the Owner's Representative with the administration of the Contract as indicated in these Contract Documents.

**4.1.2** If, in the judgment of the Owner's Representative, it becomes necessary to accelerate the Work, the Contractor, when directed by the Owner's Representative in writing, shall cease work at any point and transfer its workers to such point or points and execute such portions of the Work as may be required to enable others to hasten and properly engage and carry out the Work, all as directed by the Owner's Representative. The additional cost of accelerating the Work, if any, will be borne by the Owner, unless the Contractor's work progress is behind schedule as shown on the most recent progress schedule.

**4.1.3** If the Contractor refuses, for any reason, to proceed with what the Owner believes to be Contract Work, the Owner may issue a Construction Directive, directing the Contractor to proceed. The Contractor shall be obligated to promptly proceed with such work. If the Contractor feels that it is entitled to additional compensation as a result of a Construction Directive, it may file a claim for additional compensation and/or time, in accordance with 4.4 of this Contract.

**4.1.4** The Owner's Representative, may, by written notice, require the Contractor to remove from involvement with the Work, any of the Contractor's personnel or the personnel of its Subcontractors of any tier whom the Owner's Representative may deem abusive, incompetent, careless, or a hindrance to proper and timely execution of the Work. The Contractor shall comply with such notice promptly, but without detriment to the Work or its progress.

**4.1.5** The Owner's Representative will schedule Work status meetings that shall be attended by representatives of the Contractor and appropriate Subcontractors of any tier. Material suppliers shall attend status meetings if required by the Owner's Representative. These meetings shall include preconstruction meetings.

**4.1.6** The Owner does not allow smoking on University property.

### **4.2 Rights of the Architect**

**4.2.1** The Architect will interpret requirements of the Contract Documents with respect to the quality, quantity, and other technical requirements of the Work itself within a reasonable time after written request of the Contractor. The

Contractor shall provide Owner's Representative a copy of such written request.

#### **4.3 Review of the Work**

**4.3.1** The Architect, the Owner's Representative, and the Owner's Authorized Agent shall, at all times, have access to the Work; and the Contractor shall provide proper and safe facilities for such access.

**4.3.2** The Owner's Representative shall have authority to reject Work that does not strictly comply with the requirements of the Contract Documents. Whenever the Owner's Representative considers it necessary or advisable for implementation of the intent of the Contract Documents, Owner's Representative shall have the authority to require additional inspection or testing of the Work, whether or not such Work is fabricated, installed, or completed.

**4.3.3** The fact that the Architect or the Owner's Representative observed, or failed to observe, faulty Work, or Work done which is not in accordance with the Contract Documents, regardless of whether or not the Owner has released final payment, shall not relieve the Contractor from responsibility for all damages and additional costs of the Owner as a result of defective or faulty Work.

#### **4.4 Claims**

**4.4.1** A Claim is a demand or assertion by the Contractor seeking, as a matter of right, adjustment or interpretation of Contract terms, payment of money, extension of time or any other relief with respect to the terms of the Contract. The term "Claim(s)" also includes demands and assertions of the Contractor arising out of or relating to the Contract Documents, including Claims based upon breach of contract, mistake, misrepresentation, or other cause for Contract Modification or rescission. Claims must be made by written notice. The Contractor shall have the responsibility to substantiate Claims.

**4.4.2** Claims by the Contractor must be made promptly, and no later than within fourteen (14) days after occurrence of the event giving rise to such Claim. Claims must be made by written notice. Such notice shall include a detailed statement setting forth all reasons for the Claim and the amount of additional money and additional time claimed by the Contractor. The notice of Claims shall also strictly comply with all other provisions of the Contract Documents. The Contractor shall not be entitled to rely upon any grounds or basis for additional money or additional time not specifically set forth in the notice of Claim. All Claims not made in the manner provided herein shall be deemed waived and of no effect. The Contractor shall furnish the Owner and the Architect such timely written notice of any Claim provided for herein, including, without limitation, those in connection with alleged concealed or unknown conditions, and shall cooperate with the Owner and the Architect in any effort to mitigate the alleged or potential damages, delay or

other adverse consequences arising out of the condition which is the cause of such a Claim.

**4.4.3** Pending final resolution of a Claim, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments that are not in dispute in accordance with the Contract Documents.

#### **4.5 Claims for Concealed or Unknown Conditions**

**4.5.1** If conditions are encountered at the site which are (1) subsurface or otherwise concealed physical conditions which differ materially from those indicated in the Contract Documents, or (2) unknown physical conditions of an unusual nature, which differ materially from those ordinarily found to exist and generally recognized as inherent in construction activities of the character provided for in the Contract Documents, then notice by the Contractor shall be given to the Owner's Representative promptly before conditions are disturbed, and in no event later than three (3) days after first observance of the conditions. The Owner's Representative will promptly investigate such conditions. If such conditions differ materially, as provided for above and cause an increase or decrease in the Contractor's cost, or time, required for performance of the Work, an equitable adjustment in the Contract Sum or Contract Time, or both, shall be made, subject to the provisions and restrictions set for herein. If the Owner's Representative determines that the conditions at the site are not materially different from those indicated in the Contract Documents, and that no change in the terms of the Contract is justified, the Owner's Representative will so notify the Contractor in writing. If the Contractor disputes the finding of the Owner's Representative that no change in the terms of the Contract terms is justified, the Contractor shall proceed with the Work, taking whatever steps are necessary to overcome or correct such conditions so that Contractor can proceed in a timely manner. The Contractor may have the right to file a Claim in accordance with the Contract Documents.

**4.5.2** It is expressly agreed that no adjustment in the Contract Time or Contract Sum shall be permitted, however, in connection with a concealed or unknown condition which does not differ materially from those conditions disclosed or which reasonably should have been disclosed by the Contractor's (1) prior inspections, tests, reviews and preconstruction investigations for the Project, or (2) inspections, tests, reviews and preconstruction inspections which the Contractor had the opportunity to make or should have performed in connection with the Project.

#### **4.6 Claim for Additional Cost**

**4.6.1** If the Contractor makes a Claim for an increase in the Contract Sum, written notice as provided herein shall be given before proceeding to execute the Work. In addition to all other requirements for notice of a Claim, said notice shall detail and itemize the amount of all Claims and shall contain sufficient data to permit evaluation of same by the Owner.

#### **4.7 Claims for Additional Time**

**4.7.1** If the Contractor makes a Claim for an increase in the



Contract Time, written notice as provided herein shall be given. In addition to other requirements for notice of a Claim, the Contractor shall include an estimate of the probable effect of delay upon the progress of the Work, utilizing a CPM Time Impact Schedule Analysis, (TIA) as defined in the AGC Scheduling Manual. In the case of a continuing delay, only one Claim is necessary.

.1 Time extensions will be considered for excusable delays only. That is, delays that are beyond the control and/or contractual responsibility of the Contractor.

**4.7.2** If weather days are the basis for a Claim for additional time, such Claim shall be documented by the Contractor by data acceptable to the Owner's Representative substantiating that weather conditions for the period of time in question, had an adverse effect on the critical path of the scheduled construction. Weather days shall be defined as days on which critical path work cannot proceed due to weather conditions (including but not limited to rain, snow, etc.), in excess of the number of days shown on the anticipated weather day schedule in the Special Conditions. To be considered a weather day, at least four (4) working hours must be lost due to the weather conditions on a critical path scope item for that day. Weather days and anticipated weather days listed in the Special Conditions shall only apply to Monday through Friday. A weather day claim cannot be made for Saturdays, Sundays, New Year's Day, Martin Luther King Day, Memorial Day, Independence Day, Labor Day, Thanksgiving Day, the day after Thanksgiving Day and Christmas Day, unless that specific day was approved in writing for work by the Owner's Representative.

.1 The Contractor must have fulfilled its contractual obligations with respect to temporary facilities and protection of its work, and worker protection for hot and cold weather per OSHA guidelines.

.2 If the contractual obligations have been satisfied, the Owner will review requests for non-compensable time extensions for critical path activities as follows:

.2.1 If the Contractor cannot work on a critical path activity due to adverse weather, after implementing all reasonable temporary weather protection, the Contractor will so notify the Owner's Representative. Each week, the Contractor will notify the Owner's Representative of the number of adverse weather days that it believes it has experienced in the previous week. As provided in the Contract, until such time as the weather days acknowledged by the Owner's Representative exceed the number of days of adverse weather contemplated in the Special Conditions, no request for extension of the Contract Time will be considered.

.2.2 If the Contractor has accumulated in excess of the number of adverse weather days contemplated in the Special Conditions due to the stoppage of work on critical path activities due to adverse weather, the Owner will consider a time extension request from the Contractor that is submitted in accordance with the Contract requirements. The Owner will provide a Change Order extending the time for contract completion or direct an acceleration of the

Work in accordance with the Contract terms and conditions to recover the time lost due to adverse weather in excess of the number of adverse weather working days contemplated in the Special Conditions.

**4.7.3** A Force Majeure event or circumstance shall not be the basis of a claim by the Contractor seeking an adjustment in the Contract amount for costs or expenses of any type. With the exception of weather delays, which are administered under Article 4, and not withstanding other requirements of the Contract, all Force Majeure events resulting in a delay to the critical path of the project shall be administered as provided in Article 8.

**4.7.4** The Owner will consider and evaluate requests for time extensions due to changes or other events beyond the control of the Contractor on a monthly basis only, with the submission of the Contractor's updated schedule, in conjunction with the monthly application for payment.

#### **4.8 Resolution of Claims and Disputes**

**4.8.1** The Owner's Representative will review Claims and take one or more of the following preliminary actions within ten days of receipt of a Claim: (1) request additional supporting data from the Contractor, (2) reject the Claim in whole or in part, (3) approve the Claim, or (4) suggest a compromise.

**4.8.2** If a Claim has not been resolved, the Contractor shall, within ten (10) days after the Owner's Representative's preliminary response, take one or more of the following actions: (1) submit additional supporting data requested, (2) modify the initial Claim, or (3) notify the Owner's Representative that the initial Claim stands.

**4.8.3** If a Claim has not been resolved after consideration of the foregoing and of further information presented by the Contractor, the Contractor has the right to seek administrative review as set forth in Section 4.9. However, Owner's Representative's decisions on matters relating to aesthetics will be final.

#### **4.9 Administrative Review**

**4.9.1** Claims not resolved pursuant to the procedures set forth in the Contract Documents except with respect to Owner's Representative's decision on matters relating to aesthetic effect, and except for claims which have been waived by the making or acceptance of final payment, or the Contractor's acceptance of payments in full for changes in work may be submitted to administrative review as provided in this Section. All requests for administrative review shall be made in writing.

**4.9.2** Upon written request from the Contractor, the Owner's Review Administrator authorized by the Campus Contracting Officer will convene a review meeting between the Contractor and Owner's Representative within fifteen (15) days of receipt of such written request. The Contractor and Owner's Representative will be allowed to present written

documentation with respect to the Claim(s) before or during the meeting. The Contractor and Owner's Representative will be allowed to present the testimony of any knowledgeable person regarding the Claim at the review meeting. The Owner's Review Administrator will issue a written summary of the review meeting and decision to resolve the Claim within fifteen (15) days. If the Contractor is in agreement with the decision the Contractor shall notify the Owner's Review Administrator in writing within five (5) days, and appropriate documentation will be signed by the parties to resolve the Claim.

**4.9.3** If the Contractor is not in agreement with the proposal of the Owner's Review Administrator as to the resolution of the Claim, the Contractor may file a written appeal with the UM System Contracting Officer, [in care of the Executive Director of Facilities Planning and Development, University of Missouri, 130 General Services Building, University of Missouri, Columbia, Missouri 65211] within fifteen (15) days after receipt of the Owner's Review Administrator's proposal. The UM System Contracting Officer will call a meeting of the Contractor, the Owner's Representative, and the Owner's Review Administrator by written notice, within thirty (30) days after receipt of the Contractor's written appeal. The Owner's Review Administrator shall provide the UM System Contracting Officer with a copy of the written decision and summary of the review meeting, the Contractor's corrections, or comments regarding the summary of the review meeting, and any written documentation presented by the Contractor and the Owner's Representative at the initial review meeting. The parties may present further documentation and/or present the testimony of any knowledgeable person regarding the Claim at the meeting called by the UM System Contracting Officer.

**4.9.4** The UM System Contracting Officer will issue a written decision to resolve the claim within fifteen (15) days after the meeting. If the Contractor is in agreement with the UM System Contracting Officer's proposal, the Contractor shall notify the UM System Contracting Officer in writing within five (5) days, and the Contractor and the Owner shall sign appropriate documents. The issuance of the UM System Contracting Officer's written proposal shall conclude the administrative review process even if the Contractor is not in agreement. However, proposals and any opinions expressed in such proposals issued under this Section will not be binding on the Contractor nor will the decisions or any opinions expressed be admissible in any legal actions arising from the Claim and will not be deemed to remove any right or remedy of the Contractor as may otherwise exist by virtue of Contract Documents or Law. The Contractor and the Owner agree that the Missouri Circuit Court for the County where the Work is located shall have exclusive jurisdiction to determine all issues between them. The Contractor agrees not to file any

complaint, petition, lawsuit or legal proceeding against the Owner except with such Missouri Circuit Court.

## **ARTICLE 5 SUBCONTRACTORS**

### **5.1 Award of Subcontracts**

**5.1.1** Pursuant to Article 9, the Contractor shall furnish the Owner and the Architect, in writing, with the name, and trade for each Subcontractor and the names of all persons or entities proposed as manufacturers of products, materials and equipment identified in the Contract Documents and where applicable, the name of the installing contractor. The Owner's Representative will reply to the Contractor in writing if the Owner has reasonable objection to any such proposed person or entity. The Contractor shall not contract with a proposed person or entity to whom the Owner has made reasonable and timely objection.

**5.1.2** The Contractor may request to change a Subcontractor. Any such request shall be made in writing to the Owner's Representative. The Contractor shall not change a Subcontractor, person, or entity previously disclosed if the Owner makes reasonable objection to such change.

**5.1.3** The Contractor shall be responsible to the Owner for acts, defaults, and omissions of its Subcontractors of any tier.

### **5.2 Subcontractual Relations**

**5.2.1** By appropriate agreement, written where legally required for validity, the Contractor shall require each Subcontractor of any tier, to the extent of the Work to be performed by the Subcontractor of any tier, to be bound to the Contractor by terms of the Contract Documents and to assume toward the Contractor all the obligations and responsibilities which the Contractor, by these Documents, assumes toward the Owner and the Architect. Each subcontract agreement of any tier shall preserve and protect the rights of the Owner and the Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor of any tier so that subcontracting thereof will not prejudice such rights and shall allow to the Subcontractor of any tier, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies, and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the Contractor shall require each Subcontractor to enter into similar agreements with its sub-subcontractors. The Contractor shall make available to each proposed Subcontractor of any tier, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor of any tier shall be bound. Subcontractors of any tier shall similarly make copies of applicable portions of such documents available to their respective proposed Subcontractors of any tier.

**5.2.2** All agreements between the Contractor and a Subcontractor or supplier shall contain provisions whereby Subcontractor or supplier waives all rights against the Owner,

Contractor, Owner's Representative, the Architect and all other Additional Insureds for all losses and damages caused by, arising out of, or resulting from any of the perils covered by property or builders risk insurance coverage required of the Contractor in the Contract Documents. If Contractor fails to include said provisions in all subcontracts, Contractor shall indemnify, defend and hold all the above entities harmless in the event of any legal action by Subcontractor or supplier. If insureds on any such policies require separate waiver forms to be signed by any Subcontractors of any tier or suppliers, Contractor shall obtain the same.

### **5.3 Contingent Assignment of Subcontract**

**5.3.1** No assignment by the Contractor of any amount or any part of the Contract or of the funds to be received thereunder will be recognized unless such assignment has had the written approval of the Owner, and the surety has been given due notice of such assignment and has furnished written consent hereto. In addition to the usual recitals in assignment Contracts, the following language must be set forth: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor of the Contract and to claims and to liens for services rendered or materials supplied for the performance of the Work called for in said Contract in favor of all persons, firms or corporations rendering such services or supplying such materials."

## **ARTICLE 6**

### **SEPARATE CONTRACTS AND COOPERATION**

**6.1** The Owner reserves the right to let other contracts in connection with the Work.

**6.2** It shall be the duty of each Contractor to whom Work may be awarded, as well as all Subcontractors of any tier employed by them, to communicate immediately with each other in order to schedule Work, locate storage facilities, etc., in a manner that will permit all Contractors to work in harmony in order that Work may be completed in the manner and within the time specified in the Contract Documents.

**6.3** No Contractor shall delay another Contractor by neglecting to perform the Contractor's work at the proper time. Each Contractor shall be required to coordinate the Contractor's work with other Contractors to afford others reasonable opportunity for execution of their work. Any costs caused by defective, non-compliant, or ill-timed work, including actual damages and liquidated damages for delay, if applicable, shall be borne by the Contractor responsible therefor.

**6.4** Each Contractor shall be responsible for damage to the Owner's or another Contractor's property done by the Contractor or the Contractor's employees, through his or their fault or negligence. If any Contractor shall cause

damage to any other Contractor, the Contractor causing such damage shall upon notice of any claim, settle with such Contractor.

**6.5** The Contractor shall not claim from the Owner money damages or extra compensation under this Contract when delayed in initiating or completing his performance hereunder, when the delay is caused by labor disputes, acts of God, or the failure of any other Contractor to complete the Contractor's performance under any Contract with the Owner, where any such cause is beyond the Owner's reasonable control.

**6.6** Progress schedule of the Contractor for the Work shall be submitted to other Contractors as necessary to permit coordinating their progress schedules.

**6.7** If Contractors or Subcontractors of any tier refuse to cooperate with the instructions and reasonable requests of other contractors performing work for the Owner under separate contract, in the overall coordinating of the Work, the Owner's Representative may take such appropriate action and issue such instructions as in his judgement may be required to avoid unnecessary and unwarranted delay.

## **ARTICLE 7**

### **CHANGES IN THE WORK**

#### **7.1 CHANGE ORDERS**

**7.1.1** A Change Order is a written instrument prepared by the Owner and signed by the Owner and the Contractor formalizing their agreement on the following:

- .1** a change in the Work
- .2** the amount of an adjustment, if any, in the Contract amount
- .3** an adjustment, if any, in the Contract Time

**7.1.2** The Owner may at any time, order additions, deletions, or revisions in the Work by a Change Order or a Construction Change Directive. Such Change Order or Construction Change Directive shall not invalidate the Contract and requires no notice to the surety. Upon receipt of any such document, or written authorization from the Owner's Representative directing the Contractor to proceed pending receipt of the document, the Contractor shall promptly proceed with the Work involved in accordance with the terms set forth therein.

**7.1.3** Until such time as the Change Order is formalized and signed by both the Owner and the Contractor it shall be considered a Change Order Request.

**7.1.4** The amount of adjustment in the Contract price for authorized Change Orders will be agreed upon before such Change Orders becomes effective and will be determined as follows:

- .1** By a lump sum proposal from the Contractor and the Subcontractors of any tier, including overhead and profit.

.2 By a time and material basis with or without a specified maximum. The Contractor shall submit to the Owner's Representative itemized time and material sheets depicting labor, materials, equipment utilized in completing the Work on a daily basis for the Owner's Representative approval. If this pricing option is utilized, the Contractor may be required to submit weekly reports summarizing costs to date on time and material Change Order Requests not yet finalized.

.3 By unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or subsequently agreed upon. Such unit prices contained in the Contractor's original proposal are understood to include the Contractor's overhead and profit. If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are so changed in a proposed Change Order that application of such unit prices to quantities of the Work proposed will cause substantial inequity to the Owner or to the Contractor, the applicable unit prices shall be equitably adjusted.

**7.1.5** The Contractor shall submit all fully documented Change Order Requests with corresponding back-up documentation within the time requested by the Owner but no later than fourteen (14) working days following 1.) the Owner's request for pricing in the case of a lump sum; or 2.) the completion of unit price or time and material work.

**7.1.6** The Contractor shall submit Change Order Requests in sufficient detail to allow evaluation by the Owner. Such requests shall be fully itemized by units of labor, material and equipment and overhead and profit. Such breakdowns shall be itemized as follows:

.1 Labor: The Contractor's proposal shall include breakdowns by labor, by trade, indicating number of hours and cost per hour for each Subcontractor as applicable. Such breakdowns shall only include employees in the direct employ of the Contractor or Subcontractors in the performance of the Work. Such employees shall only include laborers at the site, mechanics, craftsmen and foremen. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by Owner.

.2 Material, supplies, consumables and equipment to be incorporated into the Work at actual invoice cost to the Contractor or Subcontractors; breakdowns showing all material, installed equipment and consumables fully itemized with number of units installed and cost per unit extended. Any singular item or items in aggregate greater than one thousand dollars (\$1,000) in cost shall be

supported with supplier invoices at the request of the Owner's Representative. Normal hand tools are not compensable.

.3 Equipment: Breakdown for required equipment shall itemize (at a minimum) delivery / pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

## **7.2 Construction Change Directive**

**7.2.1** A construction change directive is a written order prepared and signed by the Owner, issued with supporting documents prepared by the Architect (if applicable), directing a change in the Work prior to agreement on adjustment of the Contract amount or Contract Time, or both. A Construction Change Directive shall be used in the absence of complete agreement between the Owner and Contractor on the terms of a Change Order. If the Construction Change Directive allows an adjustment of the Contract amount or time, such adjustment amount shall be based on one of the following methods:

.1 A lump sum agreement, properly itemized and supported by substantiating documents of sufficient detail to allow evaluation.

.2 By unit prices contained in the Contractor's original proposal and incorporated in the Construction Contract or subsequently agreed upon.

.3 A method agreed to by both the Owner and the Contractor with a mutually agreeable fee for overhead and profit.

.4 In the absence of an agreement between the Owner and the Contractor on the method of establishing an adjustment of the Contract amount, the Owner, with the assistance of the Architect, shall determine the adjustment amount on the basis of expenditures by the Contractor for labor, materials, equipment, and other costs consistent with other provisions of the Contract. The Contractor shall keep and submit to the Owner an itemized accounting of all cost components, either expended or saved, while performing the Work covered under the Construction Change Directive.

**7.2.2** Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Owner of the Contractor's agreement or disagreement with the method, if any, provided in the Construction Change Directive for determining the proposed adjustment in the Contract Sum, Contract Time, or both.

**7.2.3** A Construction Change Directive signed by Contractor indicates the agreement of the Contractor therewith, including adjustment in Contract Sum and Contract Time or the method for determining them. Such agreement shall be effective immediately and shall be recorded as a Change Order.

## **7.3 Overhead and Profit**

**7.3.1** Overhead and Profit on Change Orders shall be applied as follows:

**.1** The overhead and profit charged by the Contractor and Subcontractors shall be considered to include, but not limited to, job site office and clerical expense, normal hand tools, incidental job supervision, field supervision, payroll costs and other compensation for project manager, officers, executives, principals, general managers, estimators, attorneys, auditors, accountants, purchasing and contracting agents, expeditors, time-keepers, and other personnel employed whether at the site or in principal or a branch office for general superintendent and administration of the Work.

**.2** The percentages for overhead and profit charged on Change Orders shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved but in no case shall exceed the following:

- 15% To the Contractor or the Subcontractor of any tier for Work performed with their respective forces or materials purchased
- 5% To the Contractor on Work performed by other than the Contractor's forces
- 5% To first tier Subcontractor on Work performed by his Subcontractor

**.3** The Contractor will be allowed to add 2% for the cost of bonding and insurance to their cost of work. This 2% shall be allowed on the total cost of the added work, including overhead and profit.

**.4** Not more than three mark-ups, not to exceed individual maximums shown above, shall be allowed regardless of the number of tier Subcontractors. Overhead and profit shall be shown separately for each Subcontractor of any tier and the Contractor.

**.5** On proposals covering both increases and decreases in the amount of the Contract, the application of overhead and profit shall be on the net change in direct cost for the Contractor or Subcontractor of any tier performing the Work.

**.6** The percentages for overhead and profit credit to the Owner on Change Orders that are strictly decreases in the quantity of work or materials shall be negotiated and may vary according to the nature, extent, and complexity of the Work involved, but shall not be less than the following:

Overhead and Profit

- 7.5% Credit to the Owner from the Contractor or Subcontractor of any tier for Work performed with their respective forces or materials purchased
- 2.5% Credit to the Owner from the Contractor on Work performed by other than his forces
- 2.5% Credit to the Owner from the first tier Subcontractor on Work performed by his Subcontractor of any tier

#### **7.4 Extended General Conditions**

**7.4.1** The Contractor acknowledges that the percentage mark-up allowed on Change Orders for overhead and

profit cover the Contractor's cost of administering and executing the Work, inclusive of Change Orders that increase the Contract Time. The Contractor further acknowledges that no compensation beyond the specified mark-up percentages for extended overhead shall be due or payable as a result of an increase in the Contract Time.

**7.4.2** The Owner may reimburse the Contractor for extended overhead if an extension of the Contract Time is granted by the Owner, in accordance with 4.7.1 and the Owner determines that the extension of the Contract Time creates an inequitable condition for the Contractor. If these conditions are determined by the Owner to exist, the Contractor may be reimbursed by unit prices contained in the Contractor's original bid and incorporated in the Construction Contract or by unit prices subsequently agreed upon.

**7.4.3** If unit prices are subsequently agreed upon, the Contractor's compensation shall be limited as follows:

**.1** For the portion of the direct payroll cost of the Contractor's project manager expended in completing the Work and the direct payroll cost of other onsite administrative staff not included in Article 7.3.1. Direct payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor;

**.2** Cost of the Contractor's temporary office, including temporary office utilities expense;

**.3** Cost of temporary utilities required in the performance of the Work;

**.4** Profit not to exceed 5% of the total extended overhead direct costs;

**7.4.4** All costs not falling into one of these categories and costs of the Contractor's staff not employed onsite are not allowed.

#### **7.5 Emergency Work**

**7.5.1** If, during the course of the Work, the Owner has need to engage the Contractor in emergency work, whether related to the Work or not, the Contractor shall immediately proceed with the emergency work as directed by the Owner under the applicable provisions of the Contract. In so doing, the Contractor agrees that all provisions of the Contract remain in full force and effect and the schedule for the Work is not impacted in any way unless explicitly agreed to in writing by the Owner.

### **ARTICLE 8 TIME**

#### **8.1 Progress and Completion**

**8.1.1** The Contractor acknowledges and agrees that time is of the essence of this Contract.

**8.1.2** The Contract Time is the period of time set forth in the Contract for Construction required for Substantial Completion and Final Completion of the entire Work or portions of the Work as defined in the Contract Documents. Time limits stated in the Contract Documents are of the essence of the Contract. The Contract Time may only be changed by a Change Order. By executing the Contract, the Contractor confirms that the Contract Time is a sufficient period for performing the Work in its entirety.

**8.1.3** The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, prematurely commence operations on the site or elsewhere prior to the effective date of insurance and bonds required by Article 11 to be furnished by the Contractor.

**8.1.4** The Contractor shall proceed expeditiously and diligently with adequate forces and shall achieve Substantial Completion and Final Completion within the time specified in the Contract Documents.

## **8.2 Delay in Completion**

**8.2.1** The Contractor shall be liable for all of the Owner's damages for delay in achieving Substantial Completion and/or Final Completion of the entire Work or portions of Work as set forth in the Contract Documents within the Contract Time unless liquidated damages are specifically provided for in the Contract Documents. If liquidated damages are specifically provided for in the Contract for Construction, the Contractor shall be liable for such liquidated damages as set forth in Section 8.3

**8.2.2** All time limits stated in the Contract are of the essence of the Contract. However, if the Contractor is delayed at any time in the progress of the Work by any act or neglect of the Owner or by the Owner's Representative, by changes ordered in the Work, Force Majeure including but not limited to war, armed conflict, riot, civil commotion or disorder, act of terrorism or sabotage; epidemic, pandemic, outbreaks of infectious disease or any other public health crisis, including quarantine or other employee restrictions, compliance with any law or governmental order, rule, regulation or direction, curfew restriction, act of God or natural disaster such as earthquake, volcanic activity, landslide, tidal wave, tsunami, flood, damage or destruction by lightning, drought; explosion, fire, destruction of machines, equipment, prolonged break-down of transport, telecommunication or electric current; general labor disturbance such as but not limited to boycott, strike and lock-out, occupation of factories and premises, or any other causes beyond the Contractor's reasonable control which the Owner's Representative determines may justify delay then, upon submission of the Time Impact Schedule Analysis (TIA) justifying the delay called out in Section 4.7 of these General Conditions, the Contract Time may be extended for a reasonable time to the extent such delay will prevent the Contractor from achieving Substantial

Completion and/or Final Completion within the Contract Time and if performance of the Work is not, was not or would not have been delayed by any other cause for which the Contractor is not entitled to an extension of the Contract Time under the Contract Documents. It shall be a condition precedent to any adjustment of the Contract Time that the Contractor provides the Owner's Representative with written notice of the cause of delay within seven (7) days from the occurrence of the event or condition which caused the claimed delay. If a Force Majeure is approved by the Owner as the basis for a delay claim, an adjustment in the Contract Time to the extent the Force Majeure impacts the schedule is the only remedy. No increase in the Contract Sum for any reason shall be allowed due to a Force Majeure.

**8.2.3** The Contractor further acknowledges and agrees that adjustments in the Contract Time will be permitted for a delay only to the extent such delay (1) is not caused, or could not have been anticipated, by the Contractor, (2) could not be limited or avoided by the Contractor's timely notice to the Owner of the delay, (3) prevents the Contractor from completing its Work by the Contract Time, and (4) is of a duration not less than one (1) day. Delays attributable to and within the control of a Subcontractor or supplier shall not justify an extension of the Contract Time.

**8.2.4** Notwithstanding anything to the contrary in the Contract Documents, except as otherwise noted in these General Conditions, an extension in the Contract Time, to the extent permitted under this Article, shall be the sole remedy of the Contractor for any (1) delay in the commencement, prosecution or completion of the Work, (2) hindrance or obstruction in the performance of the Work, (3) loss of productivity, or (4) other claims due to or caused by any events beyond the control of both the Owner and the Contractor defined herein as Force Majeure. In no event shall the Contractor be entitled to any compensation or recovery of any damages or any portion of damages resulting from delays caused by or within the control of the Contractor or by acts or omissions of the Contractor or its Subcontractors of any tier or delays beyond the control of both the Owner and the Contractor. If the Contractor contends that delay, hindrance, obstruction or other adverse condition results from acts or omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall provide written notice to the Owner within seven (7) calendar days of the event giving rise to such claim. The Contractor shall only be entitled to an adjustment in the Contract Sum to the extent that such acts or omissions continue after the Contractor's written notice to the Owner of such acts or omissions, but in no case shall Force Majeure be the basis of an increase in the Contract Sum. The Owner's exercise of any of its rights or remedies under the Contract Documents (including, without limitation, ordering changes in the Work, or directing suspension, rescheduling or correction of the Work) regardless of the extent or frequency of the Owner's exercise of such rights or remedies, shall not be the basis of any Claim for an increase in the Contract Sum or Contract Time. In the event Contractor is entitled to an adjustment in the Contract Sum for any delay, hindrance, obstruction or other adverse condition caused by the acts or

omissions of the Owner, the Owner's Representative or the Architect, the Contractor shall only be entitled to its actual direct costs caused thereby and the Contractor shall not be entitled to and waives any right to special, indirect, or consequential damages including loss of profits, loss of savings or revenues, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar type of damages.

**8.2.5** If the Contractor submits a progress report or any construction schedule indicating, or otherwise expressing an intention to achieve completion of the Work prior to any completion date required by the Contract Documents or expiration of the Contract Time, no liability of the Owner to the Contractor for any failure of the Contractor to so complete the Work shall be created or implied. Further, the Contractor acknowledges and agrees that even if the Contractor intends or is able to complete the Work prior to the Contract Time, it shall assert no Claim and the Owner shall not be liable to the Contractor for any failure of the Contractor, regardless of the cause of the failure, to complete the Work prior to the Contract Time.

### **8.3 Liquidated Damages**

**8.3.1** If Liquidated Damages are prescribed on the Bid Form and Special Conditions in the Contract Documents, the Owner may deduct from the Contract Sum and retain as Liquidated Damages, and not as penalty or forfeiture, the sum stipulated in the Contract Documents for each calendar day after the date specified for completion of the Work that the entire Work is not substantially complete and/or finally complete.

**8.3.2** The Owner's Representative shall establish the date of Substantial Completion and the date of Final Completion of the Work which shall be conclusive and binding on the Owner and the Contractor for the purpose of determining whether or not Liquidated Damages shall be assessed under terms hereof and the sum total amount due.

**8.3.3** Liquidated Damages or any matter related thereto shall not relieve the Contractor or the Contractor's surety of any responsibility or obligation under this Contract.

## **ARTICLE 9 PAYMENTS AND COMPLETION**

### **9.1 Commencement, Prosecution, and Completion**

**9.1.1** The Contractor shall commence Work within five (5) days upon the date of a "Notice to Proceed" from the Owner or the date fixed in the Notice to Proceed. The Contractor shall prosecute the Work with faithfulness and diligence, and the Contractor shall complete the Work within the Contract Time set forth in the Contract Documents.

**9.1.2** The Owner will prepare and forward three (3) copies of the Contract and Performance Bond to the bidder to whom the Contract for the Work is awarded and such bidder shall return two (2) properly executed prescribed copies of the Contract and Bond to the Owner.

**9.1.3** The construction period, when specified in consecutive calendar days, shall begin when the Contractor receives notice requesting the instruments listed in below. Before the Owner will issue Notice to Proceed to permit the Contractor to begin Work, the Owner shall have received the following instruments, properly executed as described in the Contract Documents. The documents below shall have been received by the Owner within fifteen (15) days after receipt of request for documents:

- .1** Contract
- .2** Bond (See Article 11)
- .3** Insurance (See Article 11)
- .4** List of Subcontractors of any tier
- .5** Affirmative Action Plan (See Article 13)

**9.1.4** In the event the Contractor fails to provide the Owner such documents, the Contractor may not enter upon the site of the Work until such documents are provided. The date the Contractor is required to commence and complete the Work shall not be affected by the Owner denying the Contractor access to the site as a result of the Contractor's failure to provide such documents and the Contractor shall not be entitled to an adjustment of the Contract Time or Contract Sum as a result of its failure to provide the Owner the required documents

**9.1.5** Contracts executed by partnerships shall be signed by all general partners of the partnership. Contracts signed by corporations shall be signed by the President or Vice President and the Secretary or Assistant Secretary. In case the Assistant Secretary or Vice President signs, it shall be so indicated by writing the word "Asst." or "Vice" in front of the words "Secretary" and "President". The corporate seal of the corporation shall be affixed. For all other types of entities, the Contractor and the person signing the Contract on behalf of the Contractor represent and warrant that the person signing the Contract has the legal authority to bind the Contractor to the Contract.

**9.1.6** Any successful bidder which is a corporation organized in a state other than Missouri or any bidder doing business in the State of Missouri under a fictitious name shall furnish, at no cost to the Owner, no later than the time at which the executed Contract for Construction, the Payment Bond, and the Performance Bond are returned, a properly certified copy of its current Certificate of Authority and License to do business in the State of Missouri. No contract will be executed by the Owner until such certificate is furnished by the bidder, unless there already is on file with the Owner a current certificate, in which event, no additional certificate will be required during the period of time for which such current certificate remains in effect.

**9.1.7** Within fifteen (15) calendar days of the issuance of a Notice to Proceed, the Contractor shall submit one (1) signed copy of the following instruments. No payment will be processed until all of these instruments are received and approved by the Owner's Representative.

- .1 Reproducible progress and payment schedule
- .2 Contractor's Schedule of Values
- .3 List of material suppliers
- .4 Itemized breakdown of all labor rates for each classification. Overhead and profit shall not be included. Payroll cost shall include base rate salaries and wages plus the cost of fringe benefits required by agreement or custom and social security contributions, unemployment, payroll taxes and workers' or workmen's compensation insurance and other customary and legally required taxes paid by the Contractor or Subcontractors. Any item or expense outside of these categories is not allowed. The expense of performing Work after regular working hours, on Saturdays, Sundays or legal holidays shall not be included in the above, unless approved in writing and in advance by the Owner.
- .5 Itemized breakdown of anticipated equipment rates (breakout operator rate). Overhead and profit shall not be included. Breakdown for required equipment shall itemize (at a minimum) delivery/ pick-up charge, hourly rate and hours used. Operator hours and rate shall not be included in the equipment breakdown. The Contractor must use the most cost-effective equipment available in the area and should not exceed the rates listed in the Rental Rate Blue Book for Construction Equipment (Blue Book). The Contractor shall submit documentation for the Blue Book to support the rate being requested.

**9.1.8** The Contractor shall be paid electronically using the Owner's web-based payment program with a direct electronic transfer from the Owner's account into the Contractor's account. The Contractor must submit the following information to the Owner's Representative:

- .1 Bank Transit Number for the Contractor's bank into which the electronic deposit will be made.
- .2 Bank Account Number for the Contractor's account into which the electronic deposit will be made.
- .3 Contractor's E-Mail address so that formal notification of the deposit by the Owner can be provided.

## **9.2 Contract Sum**

**9.2.1** The Owner shall compensate the Contractor for all Work described herein, and in the Contract Documents the Contract Sum set forth in the Contract for Construction, subject to additions and deletions as provided hereunder.

## **9.3 Schedule of Values**

**9.3.1** Within fifteen (15) days after receipt of the Notice to Proceed, the Contractor shall submit to the Owner's Representative a schedule of values allocated to various portions of the Work, prepared in such form and supported by such data to substantiate its accuracy as the Owner's Representative may require. This schedule, unless objected

to by the Owner's Representative, shall be used as a basis for reviewing the Contractor's Applications for Payment. The values set forth in such schedule may, at the Owner's option be used in any manner as fixing a basis for additions to or deletions from the Contract Sum.

**9.3.2** The progress and payment schedule of values shall show the following:

- .1 Enough detail as necessary to adequately evaluate the actual percent complete of any line item on a monthly basis, as determined by the Owner's Representative.
- .2 Line items, when being performed by a Subcontractor or material supplier, shall correlate directly back to the subcontract or purchase order amount if requested by the Owner's Representative.

## **9.4 Applications for Payment**

**9.4.1** The Contractor shall submit monthly to the Owner's Representative and the Architect an itemized Application for Payment for operations completed in accordance with the Schedule of Values. Such application shall be supported by such data substantiating the Contractor's right to payment as the Owner's Representative or the Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and reflecting retainage as provided for herein.

**9.4.2** Such applications shall not include requests for payment of amounts the Contractor does not intend to pay to a Subcontractor or material supplier

**9.4.3** Progress payments shall be made on account of materials and equipment delivered to the site and incorporated in the Work. No payments will be made for materials and equipment stored at the Project site but not yet incorporated into the Work except as provided in Paragraph 9.4.4.

**9.4.4** If approved in writing and in advance by the Owner, progress payments may be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. The Owner may in its sole discretion refuse to grant approval for payments for materials and equipment stored at the Project site but not yet incorporated in the Work. Any approval by the Owner for payment for materials and equipment delivered and suitably stored at the site, or stored offsite as noted below, for subsequent incorporation in the Work shall be conditioned upon Contractor's demonstrating that such materials and equipment are adequately protected from weather, damage, vandalism and theft and that such materials and equipment have been inventoried and stored in accordance with procedures established by or approved by the Owner. Nothing in this clause shall imply or create any liability on the part of the Owner for the Contractor's inventory and storage procedures or for any loss or damage to material, equipment or supplies stored on the site, whether incorporated into the Work or not. In the event any such loss or damage occurs, the Contractor remains solely responsible for all costs associated with replacement of the affected materials, supplies and equipment including labor and



incidental costs, and shall have no claim against the Owner for such loss.

No allowance shall be made in the project pay requests for materials not delivered to the site of the Work and incorporated into the Work, except as noted below. For the purposes of this Contract, offsite is defined as any location not owned or leased by the Owner. The Contractor shall submit a list of materials that they are requesting payment for offsite storage within sixty (60) days of Notice to Proceed.

**.1** Items considered to be major items of considerable magnitude, if suitably stored, may be allowed in project pay requests on the basis of ninety percent (90%) of invoices

**.2** Determination of acceptable “major items of considerable magnitude” and “suitably stored” shall be made by the Owner’s Representative.

**.3** Aggregate quantities of materials not considered unique to this project will not be considered for offsite storage payment.

**.4** The Contractor shall submit to the Owner’s Representative a list of the material for which application for payment for offsite storage is anticipated no less than forty-five days (45) prior to the submission of the applicable pay request. The list shall include a material description, applicable division, quantity, and discounts offered to the Owner for early payment. The Contractor shall also submit the location the material will be stored and the method of protection

**.5** The storage facility shall be subject to approval by the Owner’s representative, shall be located within an acceptable distance of the project sites as established by the Owner’s Representative and all materials for the Owner’s project must be stored separately from all other items within the storage facility and shall be labeled and stored in the name of “The Curators of the University of Missouri.”

**.6** The Owner’s Representative shall be provided a minimum of two weeks’ notice to visit the storage facility and inspect the stored material prior to submission of the pay request.

**.7** Upon favorable inspection by the Owner’s Representative, the Contractor shall, at the Owner’s option, submit a Bill of Sale on forms provided by the Owner’s Representative, transferring title of the material or equipment to “The Curators of the University of Missouri.”

**.8** An invoice provided by the supplier shall be included with the applicable pay request.

**.9** The Contractor shall remain fully responsible for all items, until acceptance of the project by the Owner.

**.10** The Contractor shall reimburse all costs incurred by the Owner in inspecting and verifying all material stored offsite, including mileage, airfare, meals, lodging and time, charged at a reasonable hourly rate.

**.11** The Contractor shall furnish and maintain insurance covering the replacement cost of the material stored offsite against all losses and shall furnish proof of coverage with the application for payment for material stored offsite.

**.12** The Contractor is responsible for all costs related to storage and handling of material stored offsite unless otherwise directed by the Owner’s Representative.

**9.4.5** The Application for Payment shall constitute a representation by the Contractor to the Owner that the Work has progressed to the point indicated; the quality of the Work covered by the Application for Payment is in accordance with the Contract Documents; and the Contractor is entitled to payment in the amount requested.

**9.4.6** The Contractor will be reimbursed for ninety-five percent (95%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made. On projects where a bond is not required, the Contractor will be reimbursed for ninety percent (90%) of the value of all labor furnished and material installed and computed in the same manner, less all previous payments made.

## **9.5 Approval for Payment**

**9.5.1** The Owner’s Representative will, within fifteen (15) days after receipt of the Contractor’s Application for Payment, either approve Contractor’s Application for Payment for such amount as the Owner’s Representative determines is properly due or notify the Contractor of the Owner’s Representative’s reasons for withholding certification in whole or in part as provided in Section 9.6.

## **9.6 Decisions to Withhold Approval**

**9.6.1** The Owner’s Representative may decide not to certify payment and may withhold approval in whole or in part, to the extent reasonably necessary to protect the Owner. If the Owner’s Representative is unable to approve payment in the amount of the Application, the Owner’s Representative will notify the Contractor as provided in Paragraph 9.5.1. If the Contractor and Owner’s Representative cannot agree on a revised amount, the Owner’s Representative will promptly issue approval for payment for the amount for which the Owner’s Representative is able to determine is due to the Contractor. The Owner’s Representative may also decide not to approve payment or, because of subsequently discovered evidence or subsequent observations, may nullify the whole or a part of approval for payment previously issued, to such extent as may be necessary in the Owner’s Representative opinion to protect the Owner from loss because of:

**.1** defective or non-compliant Work not remedied, or damage to completed Work;

**.2** failure to supply sufficient skilled workers or suitable materials;

**.3** third party claims filed or reasonable evidence indicating probable filing of such claims;

**.4** failure of the Contractor to make payments properly to Subcontractors or for labor, materials or equipment, the Owner may, at its sole option issue joint checks to Subcontractors who have presented evidence that it has not been paid in accordance with the Contract;

**.5** reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;

- .6 damage to the Owner or another contractor;
- .7 reasonable evidence that the Work will not be completed within the Contract Time or an unsatisfactory rate of progress made by the Contractor;
- .8 The Contractor's failure to comply with applicable laws;
- .9 The Contractor's or Subcontractor's failure to comply with applicable wage requirements; or
- .10 The Contractor's failure to carry out the Work in strict accordance with the Contract Documents.

9.6.2 When the above reasons for withholding approval are removed, approval will be made for amounts previously withheld.

### 9.7 Progress Payments

9.7.1 Based upon Applications for Payment submitted to the Owner by the Contractor and approvals issued by the Owner's Representative, the Owner shall make progress payments on account of the Contract Sum to the Contractor as provided below and elsewhere in the Contract Documents.

9.7.2 The period covered by each Application for Payment shall be one (1) calendar month.

9.7.3 The Owner shall make payment to the Contractor for amounts due and approved by the Owner's Representative not later than thirty (30) days after the Owner approves a properly detailed Application for Payment which is in compliance with the Contract Documents. The Owner shall not have the obligation to process or pay such Application for Payment until it receives an Application for Payment satisfying such requirements.

9.7.4 Based on the Schedule of Values submitted by the Contractor, Applications for Payment submitted by the Contractor shall indicate the actual percentage of completion of each portion of the Contractor's Work as of the end of the period covered by the Application for Payment.

9.7.5 The Contractor shall promptly pay each Subcontractor and supplier, upon receipt of payment from the Owner, out of the amount paid to the Contractor on account of such Subcontractor's or supplier's portion of the Work, the amount to which said Subcontractor or supplier is entitled, reflecting percentages actually retained from payments to the Contractor on account of each Subcontractor's or supplier's portion of the Work, in full compliance with state statute. The Contractor shall, by appropriate agreement with each Subcontractor or supplier, require each Subcontractor or supplier to make payments to Sub-subcontractors in similar manner.

9.7.6 Neither the Owner nor the Architect shall have an obligation to pay or to see to the payment of money to a Subcontractor of any tier nor a laborer or employee of the Contractor except to the extent required by law. Retainage provided for by the Contract Documents are to be retained

and held for the sole protection of the Owner, and no other person, firm or corporation shall have any claim or right whatsoever thereto.

9.7.7 An approval for payment by the Owner's Representative, a progress payment, or partial or entire use or occupancy of the Project by the Owner shall not constitute acceptance of Work not in accordance with the Contract Documents.

### 9.8 Failure of Payment

9.8.1 If the Owner is entitled to reimbursement or payment from the Contractor under or pursuant to the Contract Documents, such payment by the Contractor shall be made promptly upon demand by the Owner. Notwithstanding anything contained in the Contract Documents to the contrary, if the Contractor fails to promptly make any payment due the Owner, or the Owner incurs any costs and expenses to cure any default of the Contractor or to correct defective Work, the Owner shall have an absolute right to offset such amount against the Contract Sum and may, in the Owner's sole discretion, elect either to: (1) deduct an amount equal to that to which the Owner is entitled from any payment then or thereafter due the Contractor from the Owner, or (2) issue a written notice to the Contractor reducing the Contract Sum by an amount equal to that to which the Owner is entitled.

### 9.9 Substantial Completion

9.9.1 Substantial Completion is the stage in the progress of the Work as defined in Paragraph 1.1.14 as certified by the Owner.

9.9.2 When the Contractor considers the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall notify the Owner and the Architect. The Owner's Representative will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Owner's Representative's inspection discloses any item which is not in accordance with the requirements of the Contract Documents, the Contractor shall complete or correct such item upon notification by the Owner's Representative. The Contractor shall then submit a request for another inspection by the Owner's Representative to determine Substantial Completion. When the Work or designated portion thereof is substantially complete, the Owner will issue a Certificate of Substantial Completion. Substantial Completion shall transfer from the Contractor to the Owner responsibilities for security, maintenance, heat, utilities, damage to the Work and insurance. In no event shall the Contractor have more than thirty (30) days to complete all items on the Punch List and achieve Final Completion. Warranties required by the Contract Documents shall commence on the date of Substantial Completion or as agreed otherwise.

9.9.3 At the date of Substantial Completion, the Contractor may apply for, and if approved by Owner's Representative, the Owner, subject to the provisions herein, shall increase total payments to one hundred percent (100%) of the Contract Sum

less one hundred fifty percent (150%) of the value of any incomplete Work and unsettled claims, as determined by the Owner's Representative.

#### **9.10 Partial Occupancy or Use**

**9.10.1** The Owner may occupy or use any completed or partially completed portion of the Work at any stage when such portion is designated by separate agreement with the Contractor. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and the Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, security, maintenance, heat, utilities, damage to the Work and insurance. Consent of the Contractor to partial occupancy or use shall not be unreasonably withheld. The stage of the progress of the Work shall be determined by the Owner's Representative.

**9.10.2** Immediately before such partial occupancy or use, the Owner, and the Contractor shall jointly inspect the area to be occupied or portion of the Work to be used in order to determine and record the condition of the Work. Unless otherwise agreed upon, partial occupancy or use of a portion or portions of the Work shall not constitute acceptance of Work not complying with the requirements of the Contract Documents.

#### **9.11 Final Completion and Final Payment**

**9.11.1** Upon receipt of written notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Owner's Representative and the Architect will promptly make such inspection and, when the Owner's Representative and the Architect find the Work acceptable under the Contract Documents and the Contract fully performed, the Owner's Representative will promptly issue a final approval for payment; otherwise, the Owner's Representative will return the Contractor's Final Application for Payment to the Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application. Submission of a Final Application for Payment shall constitute a further representation that conditions listed in Paragraph 9.11.2 as precedent to the Contractor being entitled to final payment have been fulfilled. All warranties and guarantees required under or pursuant to the Contract Documents shall be assembled and delivered by the Contractor to the Owner's Representative as part of the final Application for Payment. The final approval for payment will not be issued by the Owner's Representative until all warranties and guarantees have been received and accepted by the Owner.

**9.11.2** The Owner will request the Contractor to submit the application for final payment along with a manually signed notarized letter on the Contractor's letterhead certifying that:

**.1** Labor costs, prevailing wage rates, fringe benefits and material costs have been paid.

**.2** Subcontractors of any tier and manufacturers furnishing materials and labor for the project have fully completed their Work and have been paid in full.

**.3** The project has been fully completed in accordance with the Contract Documents as modified by Change Orders.

**.4** The acceptance by the Contractor of its final payment, by check or electronic transfer, shall be and operate as a release of all claims of the Contractor against the Owner for all things done or furnished or relating to the Work and for every act or alleged neglect of the Owner arising out of the Work.

**9.11.3** Final payment constituting the entire unpaid balance due shall be paid by the Owner to the Contractor within thirty (30) days after the Owner's receipt of Contractor's Final Application for Payment which satisfies all the requirements of the Contract Documents and the Owner's receipt of all information and documents set forth in Section 9.11.

**9.11.4** No payment under this Contract, including but not limited to final payment, shall constitute acceptance by the Owner of any Work or act not in accordance with the requirements of the Contract Documents.

**9.11.5** No recourse shall be had against any member of the Board of Curators, or officer thereof, for any payment under the Contract or any claim based thereon.

### **ARTICLE 10**

#### **PROTECTION OF PERSONS AND PROPERTY**

##### **10.1 Safety Precautions and Programs**

**10.1.1** The Contractor shall at all times conduct operations under this Contract in a manner to avoid the risk of bodily harm to persons or risk of damage to any property. The Contractor shall promptly take precautions which are necessary and adequate against conditions created during the progress of the Contractor's activities hereunder which involve a risk of bodily harm to persons or a risk of damage to property. The Contractor shall continuously inspect Work, materials, and equipment to discover and determine any such conditions and shall be solely responsible for discovery, determination, and correction of any such conditions. The Contractor shall comply with applicable safety laws, standards, codes, and regulations in the jurisdiction where the Work is being performed, specifically, but without limiting the generality of the foregoing, with rules, regulations, and standards adopted pursuant to the Williams-Steiger Occupational Safety and Health Act of 1970 and applicable amendments.

**10.1.2** The Contractor and all Subcontractors to the Contract must require all on-site employees to complete the ten-hour construction safety training program required under Section 292.675, RSMo, unless they have previously completed the program and have documentation of having done so. The Contractor will forfeit a penalty to the Owner of \$2,500 plus an additional \$100 for each employee employed by the Contractor or Subcontractor, for each calendar day, or

portion thereof, such employee is employed without the required training.” (Section 292.675, RSMo).

**10.1.3** In the event the Contractor encounters on the site, material reasonably believed to be asbestos, polychlorinated biphenyl (PCB), lead, mercury, or other material known to be hazardous, which has not been rendered harmless, the Contractor shall immediately stop Work in the area affected and report the condition to the Owner’s Representative and the Architect in writing. The Work in the affected area shall not thereafter be resumed except by written agreement of the Owner’s Representative and the Contractor if in fact the material is asbestos or polychlorinated biphenyl (PCB) and has not been rendered harmless. The Work in the affected area shall be resumed in the absence of asbestos or polychlorinated biphenyl (PCB), or when it has been rendered harmless by written agreement of the Owner’s Representative and the Contractor. “Rendered Harmless” shall mean that levels of such materials are less than any applicable exposure standards, including but limited to OSHA regulations.

## **10.2 Safety Of Persons and Property**

**10.2.1** The Contractor shall take reasonable precautions for safety of, and shall provide protection to prevent damage, injury, or loss to:

- .1** students, faculty, staff, the public, construction personnel, and other persons who may be affected thereby;
- .2** the Work and materials and equipment to be incorporated therein, whether in storage on or off the site, under care, custody, or control of the Contractor or the Contractor’s Subcontractors of any tier; and
- .3** other property at the site or adjacent thereto, such as trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities not designated for removal, relocation, or replacement in the course of construction.

**10.2.2** The Contractor shall give notices and comply with applicable laws, standards, codes, ordinances, rules, regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury, or loss.

**10.2.3** The Contractor shall erect and maintain, as required by existing conditions and performance of the Contract, safeguards for safety and protection, including, but not limited to, posting danger signs and other warnings against hazards, promulgating safety regulations, and notifying owners and users of adjacent sites and utilities.

**10.2.4** When use or storage of explosives or other hazardous materials or equipment or unusual methods are necessary for execution of the Work, the Contractor shall exercise the highest degree of care and carry on such activities under supervision of properly qualified personnel.

**10.2.5** The Contractor shall promptly remedy damage and loss (other than damage or loss insured under property

insurance required by the Contract Documents) to property caused in whole or in part by the Contractor, a Subcontractor of any tier, or anyone directly or indirectly employed by any of them, or by anyone for whose acts they may be liable, and for which the Contractor is responsible under Article 10, except damage or loss attributable solely to acts or omissions of the Owner or the Architect or anyone directly or indirectly employed by either of them, or by anyone for whose acts either of them may be liable, and not attributable to the fault or negligence of the Contractor. The foregoing obligations of the Contractor are in addition to the Contractor’s other obligations stated elsewhere in the Contract.

**10.2.6** The Contractor shall designate a responsible member of the Contractor’s organization at the site whose duty shall be the prevention of accidents, and the maintaining, enforcing and supervising of safety precautions and programs. This person shall be the Contractor’s superintendent unless otherwise designated by the Contractor in writing to the Owner’s Representative and the Architect. The Contractor shall hold regularly scheduled safety meetings to instruct the Contractor’s personnel on safety practices, accident avoidance and prevention, and the Project Safety Program. The Contractor shall furnish safety equipment and enforce the use of such equipment by its employees and its Subcontractors of any tier.

**10.2.7** The Contractor shall not load or permit any part of the construction or site to be loaded so as to endanger its safety.

**10.2.8** The Contractor shall promptly report in writing to the Owner all accidents arising out of or in connection with the Work which cause death, lost time injury, personal injury, or property damage, giving full details and statements of any witnesses. In addition, if death, serious personal injuries, or serious property damages are caused, the accident shall be reported immediately.

**10.2.9** The Contractor shall promptly notify in writing to the Owner of any claims for injury or damage to personal property related to the Work, either by or against the Contractor.

## **ARTICLE 11 INSURANCE AND BONDS**

### **11.1 Insurance**

**11.1.1** The Contractor shall secure from the date of the Contract for Construction and maintain for such periods of time as set forth below, insurance of such types and in such amounts specified below, to protect the Contractor, the Owner and others against all hazards or risks of loss described below. The form of such insurance together with carriers thereof, in each case, shall be approved by the Owner, but, regardless of such approval, it shall be the responsibility of the Contractor to maintain the insurance coverages set forth herein.

**11.1.2** The Contractor shall not be allowed on the Owner's property without proof of the insurance coverages set forth herein

## **11.2 Commercial General Liability**

**11.2.1** The Contractor shall secure and maintain from the date of the Contract, and for a period of at least ten (10) years from the date of Final Completion of the entire Work, Commercial General Liability insurance ("CGL") with a combined single limit of not less than \$2,000,000 per occurrence, \$5,000,000 general aggregate, \$5,000,000 products and completed operations aggregate, and \$1,000,000 personal injury and advertising injury. General Aggregate must apply per project. An umbrella policy may be used to satisfy these limits.

**11.2.2** CGL insurance shall be written on a Commercial form CG 00 01 or an equivalent form providing the same coverages and shall cover claims and liability in connection with or resulting from the Contractor's operations and activities under the Contract, for personal injuries, occupational sickness, disease, death or damage to property of others, including loss of use resulting therefrom, arising out of any operations or activities of the Contractor, its agents, or any Subcontractors of any tier or by anyone directly or indirectly employed by either of them.

**11.2.3** CGL insurance shall include premises, operations, independent contractors, products-completed operations, personal injury and advertising injury and liability assumed under an insured contract (including the tort liability of another assumed in a business contract) coverages. In particular, and not by way of any limitation, the CGL insurance shall cover the Contractor's indemnity obligations contained in the Contract Documents.

**11.2.4** There shall be no endorsement or modification of the CGL policy limiting the scope of coverage for liability arising from blasting, explosion, collapse, or underground property damage.

**11.2.6** The Contractor waives all rights against the Owner and its agents, officers, representatives, and employees for recovery of damages to the extent those damages are covered by the CGL policy required hereunder.

## **11.3 Licensed for Use Vehicle Liability**

**11.3.1** The Contractor shall secure and maintain from the date of the Contract for Construction until the date of Final Completion of the entire Work, insurance, to be on comprehensive form, which shall protect the Contractor against any and all claims for all injuries and all damage to property arising from the use of automobiles, trucks and motorized vehicles, in connection with the performance of Work under this Contract, and shall cover the operation on or off the site of the Work of all motor vehicles licensed for

highway use whether they are owned, non-owned or hired. Such insurance shall include contractual liability coverage and shall provide coverage on the basis of the date of any accident. The liability limits under such policy shall not be less than \$2,000,000 combined single limit for bodily injury and property damage per accident.

**11.3.2** The Contractor waives all rights against the Owner and its agents, officers, directors, and employees for recovery of damages to the extent such damages are covered by the automobile liability insurance required hereunder.

## **11.4 Workers' Compensation Insurance**

**11.4.1** The Contractor shall purchase and maintain workers' compensation insurance and employers' liability insurance which shall protect the Contractor from claims for injury, sickness, disease or death of the Contractor's employees or statutory employees. The insurance policies required hereunder shall include an "all states" or "other states" endorsement. In case any Work is subcontracted, the Contractor shall require any Subcontractor of any tier to provide the insurance coverages required under this Paragraph.

**11.4.2** The Contractor's workers' compensation insurance coverage shall be in compliance with all applicable laws, including the statutes of the State of Missouri. The Contractor's employers' liability coverage limits shall not be less than \$1,000,000 each accident for bodily injury by accident or \$1,000,000 each employee for bodily injury by disease.

## **11.5 General Insurance Requirements and Professional Liability**

**11.5.1** Any Consultant/Contractor providing professional design services as part of the Contract shall be required to provide and maintain, from the date of this Contract and for a period of ten (10) years after the date of Final Completion, Professional Liability insurance, in a claims made form, to cover any claims, including but not limited to errors, omissions, and negligence, which may arise from the design and related services performed by the Consultant. The minimum limits for such policy shall be \$1,000,000.00 per claim/\$1,000,000.00 aggregate.

**11.5.2** "The officers, employees, and agents of The Curators of the University of Missouri" shall be added as Additional Insured with respect to the CGL, umbrella/excess and Automobile Liability policies required herein. A certificate of insurance evidencing all coverage required is to be provided at least ten (10) days prior to the inception date of the Contract between the Contractor and the University. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The University reserves the right to require higher limits on any contract provided notice of such requirement is stated in the request for proposals for such contract. The Contractor shall request that its insurer(s)

include the following disclaimer in any insurance policy, rider or endorsement issued pursuant to this Additional Insured requirement: "Neither the requirement for Additional Insured status nor any of the Contractor's action in compliance with such requirement, either direct or indirect, is intended to be and neither shall be construed as a waiver of any sovereign immunity, governmental immunity or any other type of immunity enjoyed by The Curators of the University of Missouri, the Board of Curators of the University of Missouri, or any of its officers, employees or agents."

The Additional Insured status must be conveyed by using the ISO CG 20 10 (2004) edition or equivalent and the ISO CG 20 37 (2004) edition. The policy shall be endorsed to be primary coverage and any other insurance carried by the Owner shall be excess only and will not contribute with Contractors' insurance. To confirm, the Endorsement should accompany the insurance certificate.

11.5.3 All insurance coverages procured by the Contractor shall be provided by agencies and insurance companies acceptable to and approved by Owner. All insurance coverage shall be provided by insurance companies that are duly licensed to conduct business in the State of Missouri as an admitted carrier, except that the Professional Liability insurance required herein may be provided by any insurance company legally authorized to do business in the State of Missouri. The form and content of all insurance coverage provided by the Contractor are subject to the approval of the Owner. All required insurance coverages shall be obtained and paid for by the Contractor. Any approval of the form, content or insurance company by the Owner shall not relieve the Contractor from the obligation to provide the coverages required herein. All insurance coverage procured by the Contractor shall be provided by insurance companies having policyholder ratings no lower than "A-" and financial ratings not lower than "XI" in the Best's Insurance Guide, latest edition in effect as of the date of the Contract, and subsequently in effect at the time of renewal of any policies required by the Contract Documents. Insurance coverages required hereunder shall not be subject to a deductible amount on a per-claim basis of more than \$10,000.00 and shall not be subject to a per-occurrence deductible of more than \$25,000.00. Insurance procured by the Contractor covering the Additional Insureds shall be primary insurance and any insurance maintained by Owner shall be excess insurance.

11.5.4 All insurance required hereunder shall provide that the insurer's cost of providing the insureds a defense and appeal, including attorneys' fees, shall be supplementary and shall not be included as part of the policy limits but shall remain the insurer's separate responsibility. The Contractor shall cause its insurance carriers for all required coverages, except for workers' compensation, to waive all rights of subrogation against the Owner and its officers, employees and agents.

11.5.5 The Contractor shall furnish the Owner with certificates, Additional Insured endorsements, policies, or binders which indicate the Contractor and/or the Owner and other Contractors (where required) are covered by the required insurance showing type, amount, class of operations covered, effective dates and dates of expiration of policies prior to commencement of the Work. The Contractor is required to maintain coverages as stated and required to notify the University of a carrier change or cancellation within two (2) business days. The University reserves the right to request a copy of the policy. The Contractor fails to provide, procure, and deliver acceptable policies of insurance or satisfactory certificates or other evidence thereof, the Owner may obtain such insurance at the cost and expense of the Contractor without notice to the Contractor.

11.5.6 With respect to all insurance coverages required to remain in force and affect after final payment, The Contractor shall provide the Owner additional certificates, policies and binders evidencing continuation of such insurance coverages along with the Contractor's application for final payment and shall provide certificates, policies and binders thereafter as requested by the Owner.

11.5.7 The maintenance in full current force and effect of such forms and amounts of insurance and bonds required by the Contract Documents shall be a condition precedent to the Contractor's exercise or enforcement of any rights under the Contract Documents.

11.5.8 Failure of the Owner to demand certificates, policies and binders evidencing insurance coverages required by the Contract Documents, approval by the Owner of such certificates, policies and binders or failure of the Owner to identify a deficiency from evidence that is provided by the Contractor shall not be construed as a waiver of the Contractor's obligations to maintain the insurance required by the Contract Documents.

11.5.9 The Owner shall have the right to terminate the Contract if the Contractor fails to maintain the insurance required by the Contract Documents.

11.5.10 If the Contractor fails to maintain the insurance required by the Contract Document, the Owner shall have the right, but not the obligation, to purchase said insurance at Contractor's expense. If the Owner is damaged by the Contractor's failure to maintain the insurance required by the Contract Documents, the Contractor shall bear all reasonable costs properly attributable to such failure.

11.5.11 By requiring the insurance set forth herein and in the Contract Documents, the Owner does not represent or warrant that coverage and limits will necessarily be adequate to protect the Contractor, and such coverages and limits shall not be deemed as a limitation on the Contractor's liability under the indemnities granted to the Owner in the Contract Documents. For those policies requiring the Owner to be added as an

Additional Insured, as set forth herein, the Owner and all other indemnified parties shall be an Additional Insured for the full limits carried by the Contractor, not just the limits required herein.

**11.5.12** If Contractor's liability policies do not contain a standard separation of insureds provision, such policies shall be endorsed to provide cross-liability coverage.

**11.5.13** If a part of the Work hereunder is to be subcontracted, the Contractor shall: (1) cover any and all Subcontractors in its insurance policies; (2) require each Subcontractor to secure insurance which will protect said Subcontractor and supplier against all applicable hazards or risks of loss designated in accordance with Article 11; and (3) require each Subcontractor or supplier to assist in every manner possible in the reporting and investigation of any accident, and upon request, to cooperate with any insurance carrier in the handling of any claim by securing and giving evidence and obtaining the attendance of witnesses as required by any claim or suit.

**11.5.14** It is understood and agreed that the insurance coverages required by the provisions of this Contract are required in the public interest and that the Owner does not assume any liability for acts of the Contractor or Subcontractors of any tier or their employees in the performance of the Contract or Work.

## **11.6 Builder's Risk Insurance**

**11.6.1** The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the State of Missouri, as an admitted carrier, builder's risk insurance on the entire Work. Such insurance shall be written on a completed value form for the entire Work. The insurance shall apply on a replacement cost basis.

**11.6.2** The insurance as required herein shall name as insureds the Owner, the Contractor, and all Subcontractors of any tier. The insurance policy shall contain a provision that the insurance will not be canceled, allowed to expire or materially changed until at least thirty (30) days prior written notice has been given to the Owner.

**11.6.3** The insurance as required herein shall cover the entire Work, including reasonable compensation for Architect's services and expenses made necessary by an insured loss. Insured property shall include portions of the Work located away from the site (including all offsite stored materials) but intended for use at the site and shall also cover portions of the Work in transit. The policy shall include as insured property scaffolding, falsework, and temporary buildings located at the site. The policy shall cover the cost of removing debris, including demolition as may be made legally necessary by the operation of any law, ordinance, or regulation.

**11.6.4** The insurance required herein shall be on an all risk form and shall be written to cover all risks of physical

loss or damage to the insured party and shall insure at least against the perils of fire and extended coverage, theft, vandalism, malicious mischief, collapse, lightning, earthquake, flood, frost, water damage, windstorm and freezing.

**11.6.5** If there are any deductibles applicable to the insurance required herein, the Contractor shall pay any part of any loss not covered because of the operation of such deductibles.

**11.6.6** The insurance as required herein shall be maintained in effect until the earliest of the following dates:

- .1** the date which all persons and organization who are insureds under the policy agree in writing that it shall be terminated;
- .2** the date on which final payment of this Contract has been made by the Owner to the Contractor; or
- .3** the date on which the insurable interests in the property of all insureds other than the Owner have ceased.

**11.6.7** The Owner and the Contractor waive all rights against (1) each other and any of their Subcontractors of any tier, suppliers, agents and employees, each of the other, (2) the Architect and Architect's consultants, and (3) separate contractors described in Article 6, if any, and any of their subcontractors of any tier, suppliers, agents and employees, for damages caused by fire or other perils to the extent covered by property insurance or other insurance applicable to the Work, except such rights as they have to proceeds of such insurance. The Owner or the Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6, if any, and the Subcontractors of any tier, suppliers, agents, and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, was at fault or was negligent in causing the loss and whether or not the person or entity had an interest in the property damaged.

**11.6.8** A loss insured under the Contractor's property insurance shall be adjusted by the Owner in good faith and made payable to the Owner for the insureds, subject to requirements of the Contract Documents. The Contractor shall pay Subcontractors of any tier their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors of any tier to make payments to their Subcontractors in similar manner. The Contractor shall waive its rights to subrogation for any loss or damage to the Contractor's property or equipment coverage in favor of the Owner and other indemnified parties.

## **11.7 Bonds**

**11.7.1** When the Contract Sum exceeds Fifty Thousand Dollars (\$50,000), the Contractor shall procure and furnish a Performance Bond and a Payment Bond in the form prepared by the Owner, each in an amount equal to one hundred percent (100%) of the Contract Sum, as well as adjustments to the Contract Sum. The Performance Bond shall secure and guarantee the Contractor's faithful performance of this Contract, including but not limited to the Contractor's obligation to correct defects after final payment has been made as required by the Contract Documents. The Payment Bond shall secure and guarantee payment of all persons performing labor on the Project under this Contract and furnishing materials in connection with this Contract. These Bonds shall be in effect through the duration of the Contract plus the Guaranty Period as required by the Contract Documents.

**11.7.2** The bonds required hereunder shall be executed by a responsible surety licensed in the State of Missouri, with a Best's rating of no less than A-/XI. The Contractor shall require the attorney in fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of this power of attorney indicating the monetary limit of such power.

**11.7.3** If the surety of any bond furnished by the Contractor is declared bankrupt or becomes insolvent or its right to conduct business in the State of Missouri is terminated, or it ceases to meet the requirements of this Section, the Contractor shall within ten (10) days substitute another bond and surety, both of which must be acceptable to the Owner. If Contractor fails to make such substitution, the Owner may procure such required bonds on behalf of the Contractor at the Contractor's expense.

**11.7.4** Upon the request of any person or entity appearing to be a potential beneficiary of bonds covering payment of obligations arising under the Contract, the Contractor shall promptly furnish a copy of the bonds to such person or entity.

**11.7.5** The Contractor shall keep the surety informed of the progress of the Work, and, where necessary, obtain the surety's consent to or waiver of: (1) notice of changes in the Work; (2) request for reduction or release of retention; (3) request for final payment; and (4) any other material required by the surety. The Owner shall be notified by the Contractor, in writing, of all communications with the surety, as it relates to items one through four. The Owner may, in the Owner's sole discretion, inform surety of the progress of the Work, any defects in the Work, or any defaults of the Contractor under the Contract Documents and obtain consents as necessary to protect the Owner's rights, interest, privileges and benefits under and pursuant to any bond issued in connection with the Work.

**11.7.6** The Contractor shall indemnify and hold harmless the Owner and any agents, employees, representative or member of the Board of Curators from and against any

claims, expenses, losses, costs, including reasonable attorneys' fees, as a result of any failure of the Contractor to procure the bonds required herein.

## **ARTICLE 12 UNCOVERING AND CORRECTION OF THE WORK**

### **12.1 Uncovering of the Work**

**12.1.1** If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it shall, if required in writing by the Architect or the Owner's Representative, be uncovered for the Architect's observation and be replaced at the Contractor's expense without change in the Contract Time.

**12.1.2** If a portion of the Work has been covered which the Architect or the Owner's Representative has not specifically requested to observe, prior to its being covered, the Architect or the Owner's Representative may request to see such Work, and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, costs of uncovering and replacement shall, by appropriate Change Order, be charged to the Owner. If such Work is not in accordance with the Contract Documents, the Contractor shall pay such costs unless the condition was caused by the Owner or a separate contractor in which event the Owner will be responsible for payment of such costs.

### **12.2 Correction of the Work**

**12.2.1** The Architect or the Owner's Representative shall have the right to reject Work not in strict compliance with the requirements of the Contract Documents. The Contractor shall promptly correct Work rejected by the Architect or the Owner's Representative for failing to conform to the requirements of the Contract Documents, whether observed before or after final completion and whether or not fabricated, installed, or completed. If Work has been rejected by the Architect or the Owner's Representative, the Architect or the Owner's Representative shall have the right to require the Contractor to remove it from the Project site and replace it with Work that strictly conforms to the requirements of the Contract Documents regardless, if such removal and replacement results in "economic waste." The Contractor shall pay all claims, costs, losses and damages caused by or resulting from the correction, removal or replacement of defective, or non-compliant Work, including but not limited to, all costs of repair or replacement of Work of others. The Contractor shall bear costs of correcting, removing and replacing such rejected Work, including additional testing and inspections and compensation for the Architect's services and expenses made necessary thereby. If prior to the date of final payment, the Contractor, a Subcontractor, or anyone for whom either is responsible uses or damages any portion of the Work, including, without limitation, mechanical, electrical, plumbing, and other building systems, machinery, equipment or other mechanical device, the Contractor shall cause such item to be restored to "like new" condition at no expense to the Owner.



**12.2.2** If, within twelve (12) months after the date of Final Completion of the Work or designated portion thereof, or after the date for commencement of warranties, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found not to be in strict accordance with the requirements of the Contract Documents, the Contractor shall correct or remove and replace such defective Work, at the Owner's discretion. Such twelve (12) month period is referred to as the "Guarantee Period." The obligations under this Paragraph shall cover any repairs, removal, and replacement to any part of the Work or other property caused by the defective Work.

**12.2.3** The Contractor shall remove from the site portions of the Work which are not in accordance with the requirements of the Contract Documents and are neither corrected by the Contractor nor accepted by the Owner.

**12.2.4** If the Contractor fails to correct nonconforming Work within a reasonable time, the Owner may correct or remove it and replace such nonconforming Work. If the Contractor does not proceed with correction of such nonconforming Work within a reasonable time fixed by written notice from the Owner, the Owner may take action to correct or remove the nonconforming work at the Contractor's expense.

**12.2.5** The Contractor shall bear the cost of correcting destroyed or damaged Work or property, whether completed or partially completed, of the Owner or of others caused by the Contractor's correction or removal of Work which is not in accordance with the requirements of the Contract Documents.

**12.2.6** Nothing contained in Article 12 shall be construed to establish a period of limitation with respect to other obligations that the Contractor might have under the Contract Documents. Establishment of the twelve (12) month Guarantee Period as described in Article 12 relates only to the specific obligation of the Contractor to correct, remove or replace the Work, and has no relationship to the time within which the obligation to comply with the Contract Documents may be sought to be enforced, nor to the time within which proceedings may be commenced to establish the Contractor's liability with respect to the Contractor's obligations under the Contract Documents. The requirements of Article 12 are in addition to and not in limitation of any of the other requirements of the Contract for warranties or conformance of the Work to the requirements of the Contract Documents.

### **12.3 Acceptance of Nonconforming Work**

**12.3.1** The Owner may accept Work which is not in accordance with the Contract Documents, instead of requiring its removal and correction, in its sole discretion. In such case, the Contract Sum will be adjusted as appropriate and equitable. Such adjustment shall be made

whether or not final payment has been made. Nothing contained herein shall impose any obligation upon the Owner to accept nonconforming or defective Work.

## **ARTICLE 13 MISCELLANEOUS PROVISIONS**

### **13.1 Written Notice**

**13.1.1** All notices required to be given by the Contractor under the terms of this Contract shall be made in writing. Written notice when served by the Owner will be deemed to have been duly served if delivered in person to the individual or a member of the firm or entity or to an office of the corporation for which it was intended, or if delivered at or sent to the last business address known to the party giving notice.

### **13.2 Rights and Remedies**

**13.2.1** Duties and obligations imposed by the Contract Documents and rights and remedies available thereunder shall be in addition to and not a limitation of duties, obligations, rights, and remedies otherwise imposed or available by law.

**13.2.2** No action or failure to act by the Owner, the Architect, or the Owner's Representative will constitute a waiver of a right or duty afforded to the Owner under the Contract Documents, nor will such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed in writing.

**13.2.3** The terms of this Contract and all representations, indemnifications, warranties and guarantees made in, required by, or given in accordance with the Contract Documents, as well as all continuing obligations indicated in the Contract Documents, will survive final payment, completion and acceptance of the Work and termination or completion of the Work and shall remain in effect so long as the Owner is entitled to protection of its rights under applicable law.

**13.2.4** The Contractor shall carry out the Work and adhere to the current construction schedule during all disputes or disagreements with the Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements except as the Owner and the Contractor may otherwise agree to in writing.

### **13.3 Tests and Inspections**

**13.3.1** Tests, inspections, and approvals of portions of the Work required by the Contract Documents or by laws, ordinances, rules, codes, or regulations shall be made at an appropriate time. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections and approvals with an independent testing laboratory, the Owner's Authorized Agent, or entity acceptable to the Owner, and the Contractor shall bear related costs of tests, inspections, and approvals as required in the Contract Documents. The Contractor shall give the Architect, the Owner's Representative, and the Owner's Authorized Agent timely notice of when and where tests and inspections are to be made

so the Architect, the Owner's Representative and/or the Owner's Authorized Agent may observe procedures or perform the necessary tests or inspections.

**13.3.2** If the Architect, the Owner's Representative, or the Owner's Authorized Agent determine that portions of the Work require additional testing, inspection or approval not included in the Contract Documents, or required by law, the Architect, or the Owner's Representative will instruct the Contractor to make arrangements for such additional testing, inspection, or approval by an entity acceptable to the Owner's Representative and the Contractor shall give timely notice to the Architect, the Owner's Representative or the Owner's Authorized Agent, of when and where tests and inspections are to be made so the Architect, the Owner's Representative and/or the Owner's Authorized Agent, may choose that the tests or inspections can be performed or observed. The Owner will bear such costs except as provided elsewhere in Article 13.

**13.3.3** If such procedures for testing, inspection, or approval under Article 13 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, the Contractor shall bear all costs made necessary by such failure including those of repeated procedures and compensation for the Architect's and Owner's Authorized Agent's services and expenses.

**13.3.4** Required certificates of testing, inspection, or approval shall, unless otherwise required by the Contract Documents, be secured by the Contractor, and promptly delivered to the Owner's Representative and the Architect.

**13.3.5** The Contractor shall take all necessary actions to ensure that all tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

**13.3.6** The Contractor shall arrange for and pay for all costs of all testing required by the Contract Documents or any applicable laws for materials to be tested or certified at or on the place or premises of the source of the material to be supplied. The Owner shall have the right to require testing of all materials at the place of the source of the material to be supplied if not required by the Contract Documents or any applicable laws. The Owner shall bear the costs of such tests and inspections not required by the Contract Documents or by applicable laws, unless prior defective Work provides the Architect or the Owner with a reasonable belief that additional defective Work may be found, in which case the Contractor shall be responsible for all costs of tests and inspections ordered by the Owner or the Architect, whether or not such tests or inspection reveals that Work is in compliance with the Contract Documents.

### **13.4 Nondiscrimination in Employment Equal Opportunity**

**13.4.1** The University serves from time to time as a contractor for and/or receives funds from the United States

government. Accordingly, the Contractor shall comply with applicable federal laws, rules, and regulations, including those relating to nondiscrimination, equal employment opportunity, and affirmative action in the employment of certain entities or individuals, including, but not limited to, minorities (Executive Order 11246), women (Executive Order 11375), persons with disabilities (29 USC 706 and Executive Order 11758), and certain veterans (38 USC 4212 formerly [2012]), and those related to contracting with small or disadvantaged business concerns (Publication L. 95-507). Contract clauses required by the Federal Government in such circumstances are incorporated herein by reference.

**13.4.2** If applicable, the Contractor shall comply with the equal opportunity requirements of 41 CFR Part 60, which are incorporated into this Contract by reference.

### **13.5 Supplier Diversity Participation Goals**

**13.5.1** The Contractor shall provide participation of Diverse Firms in the Project, through self-performance, if a Diverse Firm, or by subcontracting with Diverse Firms as Subcontractors, suppliers or manufacturers, in an amount that is no less than the percent of Contract Sum that was promised in the Contractor's bid and/or the amount accepted by the Owner.

**13.5.2** If the Contractor must remove any Diverse Firm as a Subcontractor, supplier or manufacturer under the Contract, the Contractor shall replace the Diverse Firm with one or more Diverse Firms in an amount equal to the dollar value of the work awarded to the Diverse Firm that was removed. The Contractor shall immediately notify the Owner's Representative in writing of the Contractor's intent to remove any Diverse Firm as a Subcontractor, supplier or manufacturer, and the Contractor's plan to provide the promised amount of Supplier Diversity Participation. All changes of a Diverse Firm as a Subcontractor of any tier, supplier or manufacturer under the Contract shall be approved by the Executive Director of Facilities Planning and Development.

**13.5.3** If the Contractor fails to meet or to maintain the promised amount of Supplier Diversity Participation, the Contractor shall immediately notify in writing the Owner's Representative and the Executive Director of Facilities Planning and Development. Such notice shall include a description of the Contractor's good faith effort to provide the promised Supplier Diversity Participation.

**13.5.4** If the Executive Director of Facilities Planning and Development finds that the Contractor has failed to comply in good faith with the promised Supplier Diversity Participation the Executive Director may take appropriate action, including but not limited to, declaring the Contractor ineligible to participate in any contracts with the Owner for a period not to exceed six (6) months, and/or directing that the Contractor's actions be declared a material breach of the Contract and that the Contract be terminated.

**13.5.5** The Contractor and his Subcontractors shall develop, implement, maintain, and submit in writing to the Executive Director of Facilities Planning and Development, an affirmative action program if at least fifty (50) persons in the aggregate are employed under this Contract. If less than fifty (50) persons in the aggregate are to be employed under this Contract, the Contractor shall submit, in lieu of the written affirmative action program, a properly executed "Affidavit for Affirmative Action" in the form as included in the Contract Documents. For the purpose of this Section, an "Affirmative Action Program" means positive actions to influence all employment practices (including, but not limited to, recruiting, hiring, promoting, and training) in providing equal employment opportunity regardless of race, color, sex, national origin, religion, age (where the person affected is between 40 and 70), disabled and Vietnam-era veteran status, and handicapped otherwise qualified status. Such affirmative action program shall include:

**.1** A written policy statement committing the total organization to affirmative action and assigning management responsibilities and procedures for evaluation and dissemination.

**.2** The identification of a person designated to handle action.

**.3** The establishment of non-discriminatory selection standards, objective measures to analyze recruitment, an upward mobility system, a wage and salary structure, and standards applicable to lay-off, recall, discharge, demotion, and discipline.

**.4** The exclusion of discrimination from collective bargaining agreements.

**.5** Performance of an internal audit of the reporting system to monitor execution and to provide for future planning.

**13.5.6** In the enforcement of the non-discrimination requirements in Section 13.4 and 13.5, the Owner may use any reasonable procedures available, including but not limited to: requests, reports, site visits, and inspection of relevant documents of Contractors and Subcontractors of any tier. The Contractor shall submit a final Affidavit of Diversity Participation for each Diverse Firm at the end of the project stating the actual amount paid to the Diverse Firm.

**13.6 Wage Rates (If the Contract amount is less than \$75,000, the requirements of this Section will not apply. Any adjustments that increase the Contract cost above \$75,000 will be subject to this Section, per Section 290.230, RSMo.)**

**13.6.1** The Contractor and its Subcontractors shall pay all workers performing work under the Contract not less than the prevailing hourly rate of wages or the public works contracting minimum wage, whichever is applicable, as set out in the Annual Wage Order that is attached to and made part of the specifications for work under the Contract, in accordance with Sections 290.210 to 290.340, RSMo

(Missouri Prevailing Wage Law) and related regulations. The Annual Wage Order(s) published by the Missouri Department of Labor and Industrial Relations (MDLIR) for the location where the Work is performed is incorporated into the Contract by this reference. The Contractor shall use applicable MDLIR regulations, including, but not limited to, 8 CSR 30-3.010-3.060, in determining the appropriate occupational titles and rates for workers used in the execution of this Contract. All determinations and/or interpretations regarding wage rates and classification of workers will be made by the office of the University of Missouri Executive Director of Facilities Planning and Development.

**13.6.2** If this Project is financed in whole or in part from Federal funds (as indicated in the bid or Contract Documents), then this Contract shall be subject to all applicable federal labor statutes, rules, and regulations, including provisions of the Davis-Bacon Act, 40 U.S.C. § 3141 et seq., and the "Federal Labor Standards Provisions." Where the Missouri Prevailing Wage Law and the Davis-Bacon Act require payment of different wages for work performed under this Contract, the Contractor and all Subcontractors shall pay the greater of the wages required under either law, on a classification-by-classification basis.

**13.6.3** The Contractor will forfeit a penalty to the Owner of \$100 per day (or portion of a day) for each worker that is paid less than the specified rate for any work done under the Contract by the Contractor or by any Subcontractor. The Owner shall deduct from any unpaid amounts then or thereafter due the Contractor under the Contract all sums and amounts due and owing as a result of any violation of Sections 290.210 to 290.340, RSMo. (Section 290.250, RSMo) The Contractor agrees to abide by any decision made by the Owner regarding underpayment of wages to workers and amounts owed them as well as penalties for underpayment of wages.

**13.6.4** The prevailing wage rate(s) and public works contracting minimum wage(s) included in the Annual Wage Order(s) include fringe benefits as set forth in Sections 290.219 and 290.257, RSMo. Fringe benefit payments may be made to the worker in cash, or irrevocably made by a Contractor or Subcontractor to a trustee or to a third person pursuant to a fund, plan or program, or pursuant to an enforceable commitment, or any combination thereof, to carry out a financially responsible plan or program which was communicated in writing to the workmen affected, for medical or hospital care, pensions on retirement or death, compensation for injuries or illness resulting from occupational activity, or insurance to provide any of the foregoing, for unemployment benefits, life insurance, disability and sickness insurance, accident insurance, for vacation and holiday pay, for defraying costs of apprenticeship or other similar programs, or for other bona fide fringe benefits, but only where the Contractor or Subcontractor is not required by other federal or state law to provide any of the benefits as referenced in Section 290.210(5), RSMo.

**13.6.5** The Contractor shall make full payment of the applicable required wages to workers in legal tender. Pay for travel, mileage, meals, bonuses, or other expenses are not fringe benefits and cannot be considered part of the workers wage rate. The Contractor shall not make any deductions for food, sleeping accommodations, transportation, use of small tools, uniforms, or anything of any kind or description, unless the Contractor and employee enter into an agreement in writing at the beginning of the worker's term of employment, and such agreement is approved by the Owner as fair and reasonable in accordance with Section 290.315, RSMo.

**13.6.6** The Contractor shall submit to the Owner with the Contractor's periodic pay request, certified payroll records for labor performed by the Contractor and Subcontractors of any tier. The Contractor shall submit all required certified payroll information records electronically in pdf format using the Owner's web-based payment program. The certified payroll forms shall contain the name, address, personal identification number, and occupational title of the workers as well as the hours they work each day. The Owner's acceptance of certified payroll records does not in any way relieve the Contractor of any responsibility for the payment of prevailing wages to workers on the project. The Contractor shall also maintain copies of the certified payroll records. The Owner may, at any time, request copies of, and/or inspect all of the Contractor's payroll records for the Work to verify compliance. The Contractor shall furnish the Owner copies of payroll records within ten (10) days of the Owner's written request. The Contractor shall provide copies of workers I-9 forms within twenty-four (24) hours of written notice. Such payroll records shall be maintained in accordance with Article 13.7.1 and shall be available for inspection for two (2) years after final completion of the Work. Falsification of the certified payroll records may result in the debarment of the Contractor or Subcontractor from future work with the University.

**13.6.7** If applicable, the Contractor shall comply with the Copeland "Anti-Kick Act, 18 U.S.C. § 874, 40 U.S.C. § 3145, and the requirements of 29 C.F.R. pt. 3 as may be applicable, which are incorporated by reference into this contract.

**13.6.8** The Contractor shall specifically incorporate the obligations of Section 13.6 into the subcontracts, supply agreements and purchase orders for the Work and require the same of any Subcontractors of any tier.

**13.6.9** If Contractor fails to comply with the provisions of Section 13.6 of this Contract or with Sections 290.210 to 290.340, RSMo and related regulations, the Owner may, in its sole discretion, immediately terminate the Contract upon written notice. The rights and remedies of the Owner provided herein shall not be exclusive and are in addition to other rights and remedies provided by law or under this Contract.

**13.6.10** The Contractor may pay entry-level workers or federally-registered apprentices fifty percent (50%) of the pay of a journeyman in their same occupational title, in accordance with Section 290.235, RSMo and 8 CSR 30-3.030. Per 8 CSR 30-3.030, an entry-level worker is "[a]ny worker who is not a journeyman and who is not otherwise enrolled in a federally-registered apprenticeship program but is participating in an on-the-job training program provided by the contractor for whom they perform work on a public construction project." The University of Missouri may require documentation showing, to the University's sole satisfaction, that an entry-level worker is participating in an on-the-job training program with the Contractor. The combined total of such entry-level workers and federally registered apprentices shall not exceed a one-to-one ratio with the number of journeyman workers in any occupational title on the project.

**13.6.11** The Contractor shall post the wage rates for the Contract in a dry, accessible place at the field office on the project or, where there is no field office, at the Contractor's local office or batch plant so long as a copy is provided to workers upon request, as required by 8 CSR 30-3.050. The wage rates shall be kept in a clearly legible condition for the duration of the project.

**13.6.12** Neither the Contractor, nor any Subcontractor of any tier, nor any person hired by them or acting on their behalf, shall request, demand or receive, either before or after such worker is engaged, that such worker pay back, return, donate, contribute, or give any part or all of said worker's wages, salary, or thing of value, to any person, upon the statement, representation, or understanding that failure to comply with such request or demand will prevent such worker from procuring or retaining employment, and no person shall, directly or indirectly, pay, request or authorize any other person to violate this Section as set forth in Section 290.305, RSMo, the exception being to an agent or representative of a duly constituted labor organization acting in the collection of dues or assessments of such organization. No Contractor or Subcontractor may directly or indirectly receive a wage subsidy, bid supplement, or rebate for employment on this project if such wage subsidy, bid supplement, or rebate has the effect of reducing the wage rate paid by the employer on a given occupational title below the applicable wage rate as provided in the Contract. In the event a wage subsidy, bid supplement, or rebate is provided or received, the entity receiving such subsidy, supplement, or rebate shall report the date and amount of such subsidy, supplement, or rebate to the University within thirty days of receipt of payment. This disclosure report shall be a matter of public record.

**13.6.13** The Contractor will pay workers overtime for all hours worked over ten (10) hours per day and forty (40) hours per week in accordance with Section 290.230, RSMo. For all overtime work performed, not less than one and one-half the prevailing hourly rate of wages for work of a similar character in the locality in which the Work is performed or the public works contracting minimum wage, whichever is applicable,

shall be paid. For all work performed on a Sunday or holiday, not less than twice the prevailing hourly rate of pay or public works contracting minimum wage will apply in accordance with Section 290.230, RSMo. For purposes of this Section, holidays are as follows: January first, the last Monday in May, July fourth, the first Monday in September, November 11, the fourth Thursday in November, December twenty-fifth. If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

### **13.7Records**

**13.7.1** The Owner, or any parties it deems necessary, shall have access to and the right to examine any accounting or other records of the Contractor involving transactions and Work related to this Contract for five (5) years after final payment or five (5) years after the final resolution of any on going disputes at the time of final payment. All records shall be maintained in accordance with generally accepted accounting procedures, consistently applied. Subcontractors of any tier shall be required by Contractor to maintain records and to permit audits as required of Contractor herein.

### **13.8Codes and Standards**

**13.8.1** The Work shall be performed to comply with the International Code Council (ICC) Codes, and the codes and standards noted below. The latest editions and supplements of these codes and standards in effect on the date of the execution of the Contract for Construction shall be applicable unless otherwise designated in the Contract Documents. Codes and standards required by accreditation agencies will also be used unless the ICC requirements are more stringent. In the event that special design features and/or construction systems are not covered in the ICC codes, the applicable edition of the National Fire Protection Association (NFPA) family of standards and/or the NFPA 101 Life Safety Code shall be used.

- .1 ICC International Building Code and reference standards
- .2 ICC International Plumbing Code
- .3 ICC International Mechanical Code
- .4 ICC International Fire Code
- .5 ICC International Fuel Gas Code
- .6 NFPA 70 National Electric Code (NEC)
- .7 Americans with Disabilities Act – Standards for Accessible Design.
- .8 American National Standard Safety Code for Elevators, Dumbwaiters, Escalators, and Moving Walks as published by the American Society of Mechanical Engineers (ASME), American National Standards Institute (ANSI) A17.1
- .9 NFPA 101 Life Safety Code (as noted above)
- .10 American Concrete Institute (ACI)
- .11 American National Standards Institute (ANSI)
- .12 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
- .13 American Refrigeration Institute (ARI)

- .14 American Society for Testing and Materials (ASTM)
- .15 Missouri Standard Specification for Highway Construction, Missouri State Highway Commission
- .16 National Electrical Manufacturers Association (NEMA)
- .17 Underwriter's Laboratories, Inc. (UL), Federal Specifications
- .18 Williams Steiger Occupational Safety and Health Act of 1970 (OSHA)

### **13.9 General Provisions**

**13.9.1** Any specific requirement in this Contract that the responsibilities or obligations of the Contractor also apply to a Subcontractor is added for emphasis and are also hereby deemed to include a Subcontractor of any tier. The omission of a reference to a Subcontractor in connection with any of the Contractor's responsibilities or obligations shall not be construed to diminish, abrogate or limit any responsibilities or obligations of a Subcontractor of any tier under the Contract Documents or the applicable subcontract.

**13.9.2** This Contract shall be interpreted, construed, enforced, and regulated under and by the laws of the State of Missouri. Whenever possible, each provision of this Contract shall be interpreted in a manner as to be effective and valid under applicable law. If, however, any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, only such provision or portion thereof shall be ineffective, without invalidating or affecting the remaining provisions of this Contract or valid portions of such provision, which are hereby deemed severable. The Contractor and the Owner further agree that in the event any provision of this Contract, or a portion thereof, is prohibited by law or found invalid under any law, this Contract shall be reformed to replace such prohibited or invalid provision or portion thereof with a valid and enforceable provision which comes as close as possible to expressing the intention of the prohibited or invalid provision.

**13.9.3** The Contractor and the Owner each agree that the State of Missouri Circuit Court for the County where the Project is located shall have exclusive jurisdiction to resolve all Claims and any issue and disputes between the Contractor and the Owner. The Contractor agrees that it shall not file any petition, complaint, lawsuit or legal proceeding against the Owner in any other court other than the State of Missouri Circuit Court for the County where the Project is located.

**13.9.4** The Owner's total liability to the Contractor and anyone claiming by, through, or under the Contractor for any Claim, cost, loss, expense, or damage caused in part by the fault of the Owner and in part by the fault of The Contractor or any other entity or individual shall not exceed the percentage share that the Owner's fault bears to the total fault of the Owner, the Contractor and all other entities and individuals as determined on the basis of comparative fault principles.

**13.9.5** The Contractor agrees that the Owner shall not be liable to the Contractor for any special, indirect, incidental, or consequential damage whatsoever, whether caused by the

Owner's negligence, fault, errors or omissions, strict liability, breach of contract, breach of warranty or other cause or causes whatsoever. Such special, indirect, incidental or consequential damages include, but are not limited to loss of profits, loss of savings or revenue, loss of anticipated profits, labor inefficiencies, idle equipment, home office overhead, and similar types of damages.

**13.9.6** Nothing contained in this Contract or the Contract Documents shall create any contractual relationship with or cause of action in favor of a third party against the Owner.

**13.9.7** No member or officer of the Board of Curators of the University incurs or assumes any individual or personal liability under the Contract or by reason of the default of the Owner in the performance of any terms thereof. The Contractor releases and discharges all members or officers of the Board of Curators of the University from any liability as a condition of and as consideration for the award of the Contract to the Contractor.

**13.9.8** The Contractor hereby binds itself, its partners, successors, assigns and legal representatives to the Owner in respect to covenants, agreements and obligations contained in the Contract Documents. The Contractor shall not assign the Contract or proceeds hereof without written consent of the Owner. If the Contractor attempts to make such an assignment without such consent, it shall be void and confer no rights on third parties, and the Contractor shall nevertheless remain legally responsible for all obligations under the Contract. The Owner's consent to any assignment is conditioned upon the Contractor entering into a written assignment which contains the following language: "It is agreed that the funds to be paid to the assignee under this assignment are subject to performance by the Contractor and to claims and to liens for services rendered or materials supplied for the performance of the Work required in said Contract in favor of all persons, firms, corporations rendering such services or supplying such materials."

### **13.10 Certifications**

#### **13.10.1 Suspension and Debarment**

The Contractor certifies to the best of its knowledge and belief that it and its principals are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any department or agency in accordance with Federal Executive Orders 12549 (2/18/86) and 12689 (8/15/89).

#### **13.10.2 Anti-Discrimination Against Israel Act**

If this Contract is for \$100,000 or more, and if the Contractor is a company with ten (10) or more employees, then Contractor certifies that it, and any company affiliated with it, does not boycott Israel, and will not boycott Israel during the term of this Contract. In this Paragraph, the terms "company" and "boycott Israel" shall have the meanings described in Section 34.600 of the Missouri Revised Statutes.

#### **13.10.3 Byrd Anti-Lobbying Amendment**

**.1** If this Contract exceeds \$100,000 and is funded by Federal funding, Contractor agrees to file the required certification, in compliance with 31 U.S.C. § 1352 (as amended).

**.2** Each tier certifies to the tier above that it will not and has not used Federal appropriated funds to pay any person or organization for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, officer or employee of Congress, or an employee of a Member of Congress in connection with obtaining any Federal contract, grant, or any other award covered by 31 U.S.C. § 1352.

**.3** Each tier shall also disclose any lobbying with non-Federal funds that takes place in connection with obtaining any Federal award. Such disclosures are forwarded from tier to tier up to the recipient who in turn will forward the certification(s) to the awarding agency.

### **13.10.4 Work Authorization**

The Contractor and all subcontractors performing work under this Contract shall enroll and participate in a federal work authorization program operated by the United States Department of Homeland Security, E-Verify or an equivalent federal work authorization program, to verify information of newly hired employees, under the Immigration Reform and Control Act of 1986 (IRCA), P.L.99-603. By executing a contract with The Curators of the University of Missouri, the Contractor shall affirm its enrollment and participation in a federal work authorization program with respect to the employees working in connection with the contracted service and affirm that it does not knowingly employ any person who is an unauthorized alien in connection with the contracted services. The Contractor shall maintain documentation of its participation in a federal work authorization program and make such documentation available to the University upon request.

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

### **14.1 Termination by Owner for Cause**

**14.1.1** In addition to other rights and remedies granted to the Owner under the Contract Documents and by law, the Owner may terminate the Contract if the Contractor:

**.1** refuses or fails to supply enough properly skilled workers, superintendents, foremen, or managers;

**.2** refuses or fails to supply sufficient or proper materials;

**.3** fails to make payment to Subcontractors for materials or labor in accordance with the respective agreements between the Contractor and the Subcontractors;

**.4** disregards laws, ordinances, rules, codes, regulations or orders of an authority having jurisdiction;

**.5** disregards the authority of the Owner's Representative, the Architect, or the Owner's Authorized Agent;

**.6** breaches any warranty or representations made by the Contractor under or pursuant to the Contract Documents;

.7 fails to furnish the Owner with assurances satisfactory to the Owner evidencing the Contractor's ability to complete the Work in compliance with all the requirements of the Contract Documents;

.8 fails after commencement of the Work to proceed continuously with the construction and completion of the Work for more than ten (10) days, except as permitted under the Contract Documents;

.9 fails to maintain a satisfactory rate of progress with the Work or fails to comply with approved progress schedules; or

.10 violates in any substantial way any provisions of the Contract Documents.

**14.1.2** When any of the above reasons exist, the Owner may, without prejudice to any other rights or remedies of the Owner, terminate this Contract by delivering a written notice of termination to the Contractor and the Contractor's surety, and may:

.1 take possession of the site and of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;

.2 accept assignment of subcontracts pursuant to Section 5.3; and

.3 finish the Work by whatever reasonable method the Owner may deem expedient, including turning the Work over to the surety.

**14.1.3** The Contractor, in the event of a termination under Section 14.1, shall not be entitled to receive any further payments under the Contract until the Work is completed in its entirety. Then, if the unpaid balance under the Contract shall exceed all expenses of the Owner in finishing the Work, including additional compensation for the Architect's services and expenses made necessary thereby, such excess will be paid to the Contractor; but, if such expenses of the Owner to finish the Work shall exceed the unpaid balance, the Contractor and its surety shall be liable for, and shall pay the difference and any damages to the Owner. The obligation of the Contractor and its surety for payment of said amounts shall survive termination of the Contract.

**14.1.4** In exercising the Owner's right to secure completion of the Work under any of the provisions hereof, the Owner shall have the right to exercise the Owner's sole discretion as to the manner, methods, and reasonableness of costs of completing the Work.

**14.1.5** The rights of the Owner to terminate pursuant to Article 14.1 will be cumulative and not exclusive and shall be in addition to any other remedy provided by law or the Contract Documents.

**14.1.6** Should the Contractor fail to achieve Final Completion of the Work within thirty (30) calendar days following the date of Substantial Completion, the Owner may exercise its rights under Section 14.1.

## **14.2 Suspension by the Owner for Convenience**

**14.2.1** The Owner may, without cause, order the Contractor in writing to suspend, delay, or interrupt the Work in whole or in part for such period of time as the Owner may determine.

**14.2.2** An adjustment will be made to the Contract Sum for increases in the cost of performance of the Contract caused by suspension, delay or interruption. However, in the event of a suspension under Section 14.2, Contractor hereby waives and forfeits any claims for payment of any special, indirect, incidental or consequential damages such as lost profits, loss of savings or revenue, loss of anticipated profits, idle labor or equipment, home office overhead, and similar type damages. No adjustment will be made to the extent:

.1 that performance is, was, or would have been so suspended, delayed or interrupted by another cause for which the Contractor in whole or in part is responsible, or

.2 that an equitable adjustment is made or denied under another provision of this Contract.

## **14.3 Owner's Termination for Convenience**

**14.3.1** The Owner may, at any time, terminate the Contract in whole or in part for the Owner's convenience and without cause. Termination by the Owner under this Paragraph shall be by a notice of termination delivered to the Contractor specifying the extent of termination and the effective date.

**14.3.2** Upon receipt of a notice of termination for convenience, the Contractor shall immediately, in accordance with instructions from the Owner, proceed with performance of the following duties regardless of delay in determining or adjusting amounts due under this Paragraph:

.1 cease operation as specified in the notice;

.2 place no further orders and enter into no further subcontracts for materials, labor, services or facilities except as necessary to complete Work not terminated;

.3 terminate all subcontracts and orders to the extent they relate to the Work terminated;

.4 proceed to complete the performance of Work not terminated; and

.5 take actions that may be necessary, or that the Owner may direct, for the protection and preservation of the terminated Work.

**14.3.3** Upon such termination, the Contractor shall recover as its sole remedy payment for Work properly performed in connection with the terminated portion of the Work prior to the effective date of termination and for items properly and timely fabricated off the Project site, delivered and stored in accordance with the Owner's instructions and for all Owner approved claims, costs, losses and damages incurred in settlement of terminated contracts with Subcontractors and suppliers. The Contractor hereby waives and forfeits all other claims for payment and damages, including, without limitation, anticipated profits, consequential damages and other economic losses.

**14.3.4** The Owner shall be credited for (1) payments previously made to the Contractor for the terminated portion of

the Work, (2) claims which the Owner has against the Contractor under the Contract and (3) the value of the materials, supplies, equipment, or other items that are to be disposed of by the Contractor that are part of the Contract Sum.

**14.3.5** Upon determination by a court that termination of Contractor or its successor in interest pursuant to Section 14.1 was wrongful, such termination will be deemed converted to a termination for convenience pursuant to Section 14.3, and Contractor's sole and exclusive remedy for wrongful termination is limited to recovery of the payments permitted for termination for convenience as set forth in 14.3.



## SECTION 1.E

### SPECIAL CONDITIONS

#### 1. DEFINITIONS

##### a. "Drawings"

Drawings referred to in and accompanying Project Manual consist of Drawings prepared by and bearing name of below defined Architect, bearing Date of September 26, 2024 entitled "Chemistry Building – 1<sup>st</sup> Floor Renovation", project number CP242331.

##### b. Architect

International Architects  
912 Broadway Blvd., Suite 300  
Kansas City, MO 64105  
(816) 471-6522

##### c. Mechanical, Electrical, and Plumbing Engineer

IMEG Corp.  
1600 Baltimore Ave., Suite 300  
Kansas City, MO 64108  
(816) 842-8437

##### d. Other Definitions: See Article 1., General Conditions.

#### 2. SPECIAL SCHEDULING REQUIREMENTS

##### a. Special scheduling requirements supplemental to the bid form:

Contractor shall perform all Base Bid work between 11/11/2024 and 05/16/2025.

Contractor may not begin selected Alternate(s) work until 05/19/2024. See General Conditions Article 1.A.4.a for Contract Period extension(s) for selected Alternate(s) work.

Normal working hours are defined as days between the hours of 7:00 am and 4:30 pm.

#### 3. SCOPE OF WORK

##### a. The Contractor shall furnish all labor, materials, tools, equipment necessary for, and incidental to, construction of this project as indicated on Drawings and specified herein.

##### b. Work shall include everything requisite and necessary to finish work

properly, notwithstanding that every item of labor or materials or accessories required to make project complete may not be specifically mentioned.

c. General Description of Work:

- (1) Project consists of the renovation of the first floor Chemistry Department Suite in the Chemistry Building (Base Bid) and the renovation of the first floor Lobby in the Chemistry Teaching Addition (Alternates 1, 2, and 3), all as indicated on the Drawings and described in these Specifications.
- (2) Demolition shall consist of the removal of existing drywall partitions with associated outlets and signage, doors, finish flooring, ceilings with lighting and diffusers, casework with associate plumbing fixtures, perimeter finned tube, ductwork, and VAV boxes in the modified Chemistry Department Suite (Base Bid). It also consists of the removal of signage, finish flooring and ceilings with lighting and diffusers in the Chemistry Teaching Addition building lobby (Alternates 1, 2, and 3). All as indicated on the Drawings and described in these Specifications.
- (3) Architectural work shall consist of new gypsum board partitions, new doors, finish flooring, ACT and gypsum board ceilings, new casework and countertops, new millwork including a reception desk and bench, interior glazing, and new signage in the Chemistry Department Suite (Base Bid). It also consists of new finish flooring, ACT and gypsum board ceilings, repainting existing walls and ceilings, new millwork, new signage and applied wall graphics, and re-staining existing doors in the Chemistry Teaching Addition building lobby (Alternates 1, 2, and 3). All as indicated on the Drawings and described in these Specifications.
- (4) Mechanical work shall consist of replacing VAV boxes, providing required HVAC system conversion, reconfiguring existing mechanical ductwork, and installing new diffusers to serve the new layout in the Chemistry Department Suite (Base Bid). It also consists of installing new diffusers in the Chemistry Teaching Addition building lobby (Alternate 1). All as indicated on the Drawings and described in these Specifications.
- (5) Electrical work shall consist of modifications to the lighting layout, new lighting, and modifications to existing power and communications systems to serve the modified Chemistry Department Suite (Base Bid). It also consists of new lighting and modifications to existing power and communications systems to serve the Chemistry Teaching Addition building lobby (Alternates 1 and 2). All as indicated on the Drawings and described in these Specifications.

## Specifications.

- (6) Plumbing work shall consist of installing a new sink and bottle filler and adjusting the water line to these new plumbing fixtures as well as fire protection reconfiguring in the Chemistry Department Suite (Base Bid). It also consists of minimal sprinkler head adjustments and sprinkler cover plate replacement in the Chemistry Teaching Addition building lobby (Alternates 1 and 2). All as indicated on the Drawings and described in these Specifications.

## 4. LOCATION

- a. Work shall be performed under this Contract on campus of the University of Missouri - Columbia, at Chemistry Building, 601 S. College Ave, Columbia, MO.

## 5. NUMBER OF CONSTRUCTION DOCUMENTS

- a. The Owner's Representative will furnish the Contractor a copy of executed Contract and a complete set of Drawings and Specifications in PDF format.
- b. The Contractor may obtain printed sets from the architect at cost of reproduction.
- c. The Owner will furnish explanatory and changed Drawings to the Contractor in PDF format as issued during project.
- d. The Owner will provide electronic data files to the Contractor for their convenience and use in progressing the Work and the preparation of shop drawings or other submittal requirements required for construction of the referenced project. The electronic data files shall reflect Construction Documents and Bid Addenda only. These files will be transmitted subject to the following terms and conditions:
  - (1) The Owner makes no representation as to the compatibility of these files with the Contractor's hardware or software.
  - (2) Data contained on these electronic files shall not be used by the Contractor or anyone else for any purpose other than as a convenience in progressing the Work or in the preparation of shop drawings or other required submittals for the referenced project. Any other use or reuse by the Contractor or by others will be at their own sole risk and without liability or legal exposure to Owner. The Contractor agrees to make no claim and hereby waive, to the fullest extent permitted by law, any claim or cause of action of any nature against the Owner and its consultants, contractors, agents, employees, and representatives that may arise out of or in connection with the use of the electronic files transmitted.

- (3) Furthermore, the Contractor shall, to the fullest extent permitted by law, indemnify and hold harmless the Owner and its consultants, contractors, agents, employees, and representatives, against all damages, liabilities or costs, including reasonable attorney's fees and defense costs, arising out of or resulting from the use of these electronic files.
- (4) These electronic files are not contract documents. Differences may exist between these electronic files and corresponding hard-copy construction documents. The Owner makes no representation regarding the accuracy or completeness of the electronic files you receive. In the event that a conflict arises between the signed or sealed hard-copy construction documents prepared by the Consultant and the electronic files, the signed and sealed hard-copy construction documents shall govern. The Contractor is responsible for determining if any conflict exists. By use of these electronic files, the Contractor is not relieved of their duty to fully comply with the contract documents.
- (5) Because information presented on the electronic files can be modified, unintentionally or otherwise, the Owner reserves the right to remove all indications of ownership and/or involvement from each electronic display.
- (6) Under no circumstances shall delivery of the electronic files be deemed a sale by the Owner and no warranties are made, either expressed or implied, of merchantability and fitness for any particular purpose. In no event shall the Owner be liable for any loss of profit, or any consequential damages as a result of use or reuse of these electronic files.

## 6. SUBMITTALS

- a. The Contractor shall submit for approval to the Architect, equipment lists and Shop Drawings, as expediently as possible. Failure of the Contractor to submit Shop Drawings in a timely manner will result in the Owner holding back Contractor payments. (See General Conditions)
- b. The material and equipment lists shall be submitted and approved before any material or equipment is purchased and shall be corrected to as-built conditions before the completion of the project.
- c. The Contractor shall submit electronic versions of all required Shop Drawings, material and equipment lists. The Contractor shall upload all Shop Drawings to a secure information sharing website determined by the Owner notifying the Owner and Consultant that these shop drawings are available for review. Each submittal shall have the General Contractors

digital stamp affixed to the first page signifying their review and acceptance. Review comments, approvals, and rejections will be posted on this same site with notification to the contractor. Submittals requiring a professional seal shall be submitted hard copy with a manual seal affixed.

(1) The Contractor shall identify each submittal item with the following:

- (a) Project Title and Location
- (b) Project Number
- (c) Supplier's Name
- (d) Manufacturer's Name
- (e) Contract Specification Section and Article Number
- (f) Contract Drawing Number
- (g) Acrobat file name: Spec Section\_Times Submitted-Spec Title:  
(Example - 033000\_01-Cast In Place Concrete.pdf)

(2) Reference the accompanying Shop Drawing and Submittal Log at the end of this section (1.E.4) for required submittal information.

d. The Contractor shall submit to the Owner's Representative all items referenced in the accompanying Closeout Log (1.E.6) within 30 days following substantial completion of the work. The Owner's Representative will maintain the closeout log and include as an agenda item at all coordination meetings.

## 7. NOTIFICATION

a. Before beginning Demolition Work or service outages, the Contractor shall provide, at minimum, seventy-two (72) hours advance notice to Owner's Representative for purpose of verifying utility locations including, but not limited to, gas, telecommunications, electric, water, steam, sewer, and nitrogen. Contractor shall minimize the number of outages, minimize the length of outages and related work shall be continuous until the utility is restored.

## 8. USE OF PREMISES

a. Access: Access to construction site shall be as indicated on Drawings and as directed by the Owner's Representative.

b. Parking:

(1) The Owner will issue Contractor two (2) service vehicle parking permits for use in University Avenue Parking Structure. After the contract completion date, the permits will be re-issued on an as available basis at the contractors' expense. These permits are to be used for general contractor or subcontractor owned and labeled vehicles only. Personal vehicles are prohibited from use of these permits. Violation of this requirement may result in ticketing and/or

towing at the vehicle owner's expense and suspension of progress payments.

- (2) Parking of personal vehicles within project access/lay down/staging areas is prohibited. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (3) Parking or driving on sidewalks, landscaped areas, within fire and service lanes or generally in areas not designated for vehicular traffic is prohibited except as allowed in the contract documents. Violation of this requirement may result in ticketing and/or towing at the vehicle owner's expense and suspension of progress payments.
- (4) Sidewalk(s) and Hardscape – Parking/driving on hardscapes is strictly prohibited unless specifically directed by the Owner's Representative through the MU sidewalk permitting process. Restricted use permits will be limited to activities that are constrained by an absolute need to access from a sidewalk. Such activities shall be considered the exception and not the norm. Adequate signage, fencing and alternate routes must be provided in the immediate and adjacent areas.
- (5) Free parking for contractor employees is available in the Ashland Road Contractor lot on an as available basis. This space is for use by contractor employees for parking their personal vehicles only and is not to be used for staging or storage.
- (6) Vendor Permits may be purchased by contractor management personnel on an as available basis by contacting the Parking and Transportation office in the General Services Building. These permits will allow contractor management personnel to park in various University lots while conducting business on University construction projects.
- (7) Temporary University parking permits may be purchased by contractor employees for use with their personal vehicles on an as available basis by contacting the Parking and Transportation office in the General Services Building.
- (8) Conley Avenue between Missouri Avenue and University Avenue and Hitt Street between University Avenue and the Memorial Union are designated for pedestrian use only during the work week between the hours of 8:15 AM and 3:45 PM. Unless otherwise indicated in the contract documents, this area is strictly off limits to vehicular traffic without authorization from the Owner's Representative.

- c. Storage of materials: The Contractor shall store all materials within project limits. The Contractor shall confine apparatus, materials, and operation of workers to location established by the Owner's Representative. The Contractor shall not unreasonably encumber premises with materials. In addition, storage trailer locations may be available within 1-1/2 miles of project site as directed by the Owner's Representative. Storage trailer locations shall be subject to approval by the Owner's Representative and are available to the Contractor without cost.
- d. Utilities: Drinking water, water required to carry on work, and 120 volt electrical power required for small tool operation may be obtained without cost to the Contractor from existing utilities at locations designated by the Owner's Representative. Provisions for obtaining power, including temporary extensions, shall be furnished and maintained by the Contractor. Upon completion of work such extensions shall be removed and any damage caused by use of such extensions shall be repaired to satisfaction of the Owner's Representative, at no cost to the Owner.
- e. Restroom: Existing toilet facilities within Project Limits or Restrooms designated by the Owner's Representative for use by the Contractor will be available. Failure of the Contractor to maintain restrooms in a clean condition will be cause for the Contractor's discontinued use of the restroom.
- f. Smoking is prohibited at the University of Missouri and all properties owned, operated, leased or controlled by the University of Missouri. Violation of the policy is defined as the use of any tobacco or marijuana products, including e-cigarettes, cigarettes, and vaping.
- g. Landfill: The Contractor shall not use the Owner's landfill. Dumping or disposal of excavated or demolition materials on Owner's property shall not be permitted. The Contractor shall remove and legally dispose of excavated or demolished materials off the Owner's property.
- h. Care of Project Work Site: The contractor shall be responsible for maintaining the construction site in a reasonably neat and orderly condition by regular cleaning and mowing of the premises as determined by the Owner's Representative.
- i. Discharge to Sewer Request: The University of Missouri's MS4 permit and NPDES Storm Water Discharge Permits along with the City of Columbia's POTW Operating Permit as well as local ordinances, and state and federal environmental regulations prohibit hazardous materials from being disposed into either the storm water or sanitary sewer systems. Unless specifically approved, all chemical products such as paints, dyes, lawn care products, maintenance products, and oil is are prohibited from drain disposal. Any product, including contaminated water, being discarded into the storm water or sanitary sewer systems requires written approval from

the Owner through a formal “Discharge to Sewer Request” form obtained at Discharge to Sewer Request Form. The contractor should submit the form to the Owner’s Representative, not to the Department of Environmental Health and Safety as the form indicates.

- j. All concrete waste material including washout water shall be totally contained and removed from the Owner’s property.
- k. Artifacts Found During Construction: Contractor shall immediately notify the Owner’s Representative when artifacts are uncovered or found during the demolition or construction process. Artifacts include, but are not limited to, tools, drawings (construction or other), photographs, books and other objects/devices which may hold historical importance/significance. Do not remove or disturb the object(s) in question. Artifacts are not considered part of demolished materials and shall remain the property of the University of Missouri.
- l. Permit Required Confined Space” Entry Communication and Coordination: (See OSHA 1926 subpart aa – Construction Confined Space for the definition of “permit required confined spaces” - Note: OSHA does not apply to the University. However, the University will provide a list of all known “permit required confined spaces”)

There are no known “permit required confined spaces” within the project limits. Each contractor shall conduct a survey to confirm whether or not any confined spaces exist within the project limits. It is incumbent upon each contractor to list all “permit required spaces”.

The Contractor shall notify the Owner’s Representative if 1) conditions change resulting in a non-permit required confined space being reclassified to a “permit required confined space” after evaluation of the space by a competent person; 2) a space previously thought to be non-permit required space is classified as a “permit required confined space”; or 3) during the course of construction a “permit required confined space” is created after evaluation by a competent person.

The Contractor shall submit to the Owner’s Representative a copy of the cancelled confined space entry permit and a written report summarizing the permit space program followed and all hazards confronted or created during entry operations. This information shall be submitted within one week of cancelling the permit.

## 9. PROTECTION OF OWNER'S PROPERTY

- a. The Contractor shall be responsible for repair of damage to building exterior and interior, drives, curbs, streets, walks, grass, shrubbery and trees, which was caused by workmen or equipment employed during progress of work.



All such repairs shall be made to satisfaction of the Owner's Representative, at no cost to the Owner, or reimburse the Owner if the Owner elects to make repairs. For landscape damage, the Owner shall make such repairs. Compensation for these repairs shall be determined by the Owner's Representative using the "Valuation of Landscape Trees, Shrubs, and other Plants" as published by the International Society of Arboriculture, as last revised.

- b. Construction Project Fencing:
  - (1) Fencing will not be required as a part of work.

## 10. SUBSTITUTIONS and EQUALS

- a. Substitutions are defined in General Conditions article 3.11.8 for and Equals are defined General Conditions Article 3.12 .
- b. Use of materials, products or equipment other than those named and described in the Contract Documents are substitutions *and/or equal*. Substitutions *and/or equals* of any item described in the Contract Documents will be allowed only prior to the receipt of bids provided that a request for approval has been received by both the Architect and the Owner at least ten calendar days prior to the date for receipt of Bids. To be considered, bidder's *proposal* shall include a complete description of the proposed substitution *and/or equal* and a comparison of significant qualities of the proposed substitution *and/or equal* with those specified including drawings, performance and test data, and other information necessary for an evaluation. The Architect's decision on the approval or disapproval of a proposed substitution *and/or equal* shall be final.
- c. If the Architect and Owner approve a proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Bidders shall not rely upon approval made in any other manner.

## 11. CODES AND STANDARDS

- a. The Contractor shall comply with applicable codes and standards as listed in General Conditions.

## 12. PERMITS

- a. Permits and inspection for work on UM property are required.
- b. The Owner's Representative shall secure University Authority Having Jurisdiction building permits required for the project and shall provide a list of required inspections to the Contractor.

- (1) The Contractor shall coordinate and provide reasonable scheduling and access to the Work for the Owner's Inspection.
    - (2) Re-inspection of work as a result of either failed inspection or work not ready as scheduled may be at the Contractor's expense.
  - e. The Contractor shall comply with applicable codes and standards as listed in the Contract Documents and General Conditions.
  - f. All permits, including, but not limited to Hot Work, Fire Alarm, Energized Work and HVAC interruption shall be coordinated and scheduled with the Owner's Representative or designee prior to commencement of the work.
  - g. The Owner will secure and pay for specific necessary approvals, easements, assessments, and charges required for construction, use or occupancy of permanent structures, or for permanent changes in existing facilities except as noted in Article 3.2 of the General Conditions.
  - h. Before commencement of Boilers, Water Heaters or Pressure Vessels the Contractor must obtain an installation permit from the State of Missouri, Division of Fire Safety, Boiler and Pressure Unit as required by 11 CSR 40-2.010 through 11 CSR 40-2.065. The permit applications are available at <http://www.dfs.dps.mo.gov/programs/bpv/>
13. SPECIALTIES (NOT USED)
14. PRE-BID INSPECTION
- a. All pre-bid inspections of work areas shall be scheduled with pre-bid inspection guide, telephone: (573) 882-6800.
15. ROOF CERTIFICATION AND WARRANTY REQUIREMENT (NOT USED)
16. MODIFICATION TO INFORMATION FOR BIDDERS
- a. Information to Bidders:
    - (1) Referenced Information to Bidders, Page IFB/6.  
Add new Article 15.9.2 as follows:  
  
**15.9.2.1** Within 48 hours of the receipt of bids, the apparent low bidder shall submit to the Director of Facilities Planning and Development an "Affidavit of Supplier Diversity Participation" for every diverse subcontractor or supplier the bidder intends to award work to on the contract. The affidavit will be signed by both the bidder and the diverse firm.

17. MODIFICATION TO INFORMATION FOR BIDDERS: BIDDERS STATEMENT OF

QUALIFICATIONS (NOT USED)

18. MODIFICATIONS TO GENERAL CONDITIONS

a. General Conditions:

- (1) Add to the Insurance Requirements in General Conditions Article 11, Asbestos Liability Coverage, for specified asbestos abatement in the contract documents, in a limit no less than \$1,000,000 combined single limit, per occurrence and aggregate, for both bodily injury and property damage combined. The Owner will accept coverage from the Asbestos Removal Subcontractor in lieu of the General Contractor subject to all requirements set forth in article 11.

19. PROJECT SCHEDULING (NOT USED)

20. PROJECT COORDINATION (NOT USED)

21. PROJECT PARTNERING (NOT USED)

22. VALUE ENGINEERING (NOT USED)

23. BUILDING SYSTEM COMMISSIONING (NOT USED)

24. MECHANICAL, ELECTRICAL, PLUMBING (MEP) PRE-INSTALLATION

25. COST BREAKOUT FOR OWNER'S ACCOUNTING PURPOSES / SPEND DOWN PURPOSES (NOT USED)

26. PROJECT MANAGEMENT/COMMUNICATION REQUIREMENTS (NOT USED)

27. SAFETY PRECAUTIONS AND PROGRAMS

- a. The Bidder's Statement of Qualifications includes a requirement that the Bidder provide its Worker's Compensation Experience Modification Rates (EMR) and Incidence Rates for the three recent years. The Bidder shall also include the EMR and Incidence Rates of listed major subcontractors on the Bid for Lump Sum Contract. If the EMR exceeds 1 or the Incidence Rate exceeds 13, the Contractor or major subcontractor shall take additional safety measures including, but not limited to, developing a site specific safety plan and assigning a Safety Manager to the Project to perform inspections on a schedule as determined acceptable by the Owner with written reports to be submitted to the Owner. The Owner reserves the right to reject a Bidder or major subcontractor whose rates exceed these stated rates.

- b. The contractor shall provide Emergency Contact Information for the Contractor's on-site staff and home office management as well as contact

information for all major subcontractor personnel. This information shall contain business and personal phone numbers for each individual for contact during or after hours in case of an emergency. This information shall be submitted within 15 days of the Notice to Proceed.

28. HOT WORK PERMITTING AND GENERAL REQUIREMENTS

- a. Hot work Requirements: The contractor shall comply with the following hot work requirements and the requirements of the International Fire Code and 2014 NFPA 51B.
- b. Hot work shall be defined as any work involving burning, welding, grinding, cutting, or similar operations that are capable of initiating fires or explosions.
- c. The Contractor shall utilize the hot work permit decision tree and permit provided in the 2014 NFPA 51B for all Hot Work operations.
- d. A hot work permit shall be used on all hot work performed outside a designated hot work area. The hot work permit shall be posted and clearly visible within proximity of the hot work area. The hot work permit authorizing individual (PAI) shall be as designated by the Contractor.
- e. Notify the Owner's Representative 24 hours prior to starting hot work in buildings with operational fire alarm or fire suppression systems. The Owner's Representative will coordinate the appropriate system outage with Campus Maintenance personnel.
- f. Unless otherwise instructed by the Owner's Representative, the Contractor shall post a copy of each completed hot work permit to the Owner's project management file system the following business day.

29. GENERAL REQUIREMENTS FOR CRANE AND HOISTING OPERATIONS (NOT USED)

30. CONSTRUCTION WASTE MANAGEMENT (NOT USED)

31. WARRANTY WALKTHROUGH

- a. Contractor shall attend a walk-thru with the Owner at 11 months after acceptance to review and document any warranty items to be addressed as part of the 12-month warranty stated in article 3.1 of the General Conditions.

**END OF SECTION**

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Bldg. – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>024119</b>	<b>Selective Demolition</b>				
	Proposed Protection Measures				
	Schedule of Selective Demolition Activities				
	Pre-demolition Photographs				
	Warranties				
<b>051200</b>	<b>Miscellaneous Structural Steel</b>				
	Product Data				
	Shop Drawings				
	Delegated Design Submittal				
<b>061000</b>	<b>Rough Carpentry</b>				
	Product Data				
	ICC-ES Reports				
	Qualification Statements				
<b>062023</b>	<b>Interior Finish Carpentry</b>				
	Product Data				
	Shop Drawings				
	Samples for Verification				
	Qualification Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>062023</b>	Product Certificates				
	Quality Standard Compliance Certificates				
	Fabricator Qualifications				
	Shop Certification				
<b>079200</b>	<b>Joint Sealants</b>				
	Product Data				
	Samples for Initial Selection				
	Samples for Verification				
	Sealant Schedule				
	Sample Warranties				
<b>079500</b>	Expansion Control				
	Product Data				
	Shop Drawings				
	Samples				
<b>081113</b>	<b>Hollow Metal Frames</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
	Shop Drawings				
	Samples for Verification				
	Product Schedule				
	Product Test Reports				
<b>081416</b>	<b>Flush Wood Doors</b>				
	Product Data				
	Shop Drawings				
	Samples for Initial Selection				
	Samples for Verification				
	Sample Warranty				
<b>084113</b>	<b>Aluminum Framed Entrances and Storefronts</b>				
	Product Data				
	Shop Drawings				
	Samples for Verification				
	Product Test Reports				
	Qualification Statements				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>081416</b>	Sample Warranties				
<b>087100</b>	<b>Door Hardware</b>				
	Product Data				
	Hardware Schedule				
	Supplier Qualifications				
<b>088000</b>	<b>Glazing</b>				
	Product Data				
	Samples				
	Product Test Reports				
<b>092216</b>	<b>Non-Structural Metal Framing</b>				
	Product Data				
	Evaluation Reports				
<b>092613</b>	<b>Gypsum Veneer Plastering</b>				
	Product Data				
	Mockups				
<b>092900</b>	<b>Gypsum Board</b>				
	Product Data				
<b>095113</b>	<b>Acoustical Panel Ceilings</b>				



SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>095113</b>	Product Data				
	Samples				
	Coordination Drawings				
	Qualification Data				
	Product Test Reports				
	Evaluation Reports				
<b>096513</b>	<b>Wall Base and Accessories</b>				
	Product Data				
	Samples for Verification				
<b>096519</b>	<b>Resilient Tile Flooring</b>				
	Product Data				
	Shop Drawings				
	Samples for Verification				
	Qualification Data				
<b>096813</b>	<b>Tile Carpeting</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>096813</b>	Samples				
	Qualification Data				
	Product Test Reports				
	Sample Warranty				
<b>097200</b>	<b>Wall Coverings</b>				
	Product Data				
	Shop Drawings				
	Samples				
	Product Schedule				
	Product Test Reports				
<b>099123</b>	<b>Interior Painting</b>				
	Product Data				
	Samples for Verification				
<b>101100</b>	<b>Visual Display Units</b>				
	Product Data				
	Shop Drawings				
	Samples for Initial Selection				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>101419</b>	<b>Dimensional Letter Signage</b>				
	Product Data				
	Shop Drawings				
	Samples for Verification				
	Product Schedule				
	Sample Warranty				
<b>102600</b>	<b>Wall and Door Protection</b>				
	Product Data				
	Samples for Initial Selection				
<b>200800</b>	<b>Seismic Protection</b>				
	Product Data				
	Product Certificates				
	Shop Drawings				
	Welder Certificates				
	Manufacturer Seismic Qualification Certification				
<b>210500</b>	<b>Common Work Results for Fire Suppression</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>210500</b>	Welding Certificates				
<b>211313</b>	<b>Wet-Pipe Sprinkler Systems</b>				
	Product Data				
	Shop Drawings				
	Delegated Design Submittal				
	Coordination Drawings				
	Qualification Data				
	Approved Sprinkler Piping Drawings				
	Welding Certificates				
	Fire-Hydrant Flow Test Reports				
	Field Test Report and Certificates				
	Field Quality Control Reports				
<b>220500</b>	<b>Common Work Results for Plumbing</b>				
	Product Data				
<b>220523</b>	<b>General-Duty Valves for Plumbing Piping</b>				
	Product Data				
	<b>Hangers and Supports for Plumbing Piping and Equipment</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
220529	Welding Certificates				
220553	<b>Identification for Plumbing Piping and Equipment</b>				
	Product Data				
	Equipment Label Schedule				
220553	Valve Numbering Scheme				
	Valve Schedules				
220700	<b>Plumbing Insulation</b>				
	Product Data				
	Shop Drawings				
221119	<b>Domestic Water Piping Specialties</b>				
	Product Data				
	Field Quality Control Reports				
221316	<b>Sanitary Waste and Vent Piping</b>				
	Product Data				
	Field Quality Control Reports				
221319	<b>Sanitary Waste and Piping Specialties</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>224000</b>	<b>Plumbing Fixtures</b>				
	Product Data				
	Shop Drawings				
<b>230500</b>	<b>Common Work Results for HVAC</b>				
	Product Data				
	Welding Certificates				
<b>230523</b>	<b>General Duty Valves for HVAC Piping</b>				
	Product Data				
<b>230529</b>	<b>Hangers and Supports for HVAC Piping and Equipment</b>				
	Product Data				
	Welding Certificates				
<b>230553</b>	<b>Identification for HVAC Piping and Equipment</b>				
	Product Data				
	Equipment Label Schedule				
	Valve Numbering Scheme				
	Valve Schedules				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>230700</b>	<b>HVAC Insulation</b>				
	Product Data				
<b>230900</b>	<b>Control Systems</b>				
	Shop Drawings				
	Product Data				
	Schematic Flow Diagrams				
	Wiring Diagrams				
	Field Routing of Proposed Network Bus Diagram				
<b>232113</b>	<b>Hydronic Piping</b>				
	Product Data				
	Shop Drawings				
	Field Test Reports				
<b>233113</b>	<b>Metal Ducts</b>				
	Product Data				
	Shop Drawings				
	Coordination Drawings				
	Field Quality Control Reports				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>233300</b>	<b>Air Duct Accessories</b>				
	Product Data				
	Shop Drawings				
	Coordination Drawings				
	Field Quality Control Reports				
<b>233600</b>	<b>Air Terminal Units</b>				
	Product Data				
	Shop Drawings				
	Coordination Drawings				
	Field Quality Control Reports				
<b>233713</b>	<b>Diffusers, Registers, and Grilles</b>				
	Product Data				
	Coordination Drawings				
<b>239100</b>	<b>Variable Frequency Motor Controllers</b>				
	Product Data				
	Shop Drawings				
	Wiring Diagrams				
	Coordination Drawings				



SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
239100	Qualification Data				
	Field Quality Control Test Reports				
260519	<b>Low-Voltage Electrical Power Conductors and Cables</b>				
	Product Data				
	Field Quality Control Test Reports				
260526	<b>Grounding and Bonding for Electrical Systems</b>				
	Product Data				
	Field Quality Control Test Reports				
260529	<b>Hangers and Supports for Electrical Systems</b>				
	Product Data				
	Shop Drawings				
	Welding Certificates				
260533	<b>Raceway and Boxes for Electrical Systems</b>				
	Product Data				
	Shop Drawings				
	Coordination Drawings				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
260548	<b>Vibration and Seismic Controls for Electrical Systems</b>				
	Product Data				
260553	<b>Identification for Electrical Systems</b>				
	Product Data				
	Identification Schedule				
260573	<b>Overcurrent Protective Device Coordination Study and Arc Flash Hazard Analysis</b>				
	Product Data				
	Product Certificates				
	Qualification Data				
	Preliminary Analysis				
	Input Data				
	Evaluation Reports				
	Study Report				
	Setting Report				
	Calculations Report				
260923	<b>Lighting Control Devices</b>				
	Product Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>260923</b>	Shop Drawings				
	Field Quality Control Test Reports				
<b>262726</b>	<b>Wiring Devices</b>				
	Product Data				
	Shop Drawings				
	Field Quality Control Test Reports				
<b>265100</b>	<b>Interior Lighting</b>				
	Product Data				
	Coordination Drawings				
	Field Quality Control Test Reports				
<b>270500</b>	<b>Common Work Results for Communications</b>				
	Product Data				
	Coordination Drawings				
	Project Record Drawings				
<b>271500</b>	<b>Communications Horizontal Cabling</b>				
	Product Data				
	Qualification Data				

SECTION 1.E.3

SHOP DRAWING AND SUBMITTAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor</i>	<i>Date Received</i>	<i>Date Returned</i>	<i>Comments</i>
<b>280500</b>	<b>Common Work Results for Electronic Safety and Security</b>				
	Product Data				
<b>280513</b>	<b>Conductors and Cables for Electronic Safety and Security</b>				
	Product Data				
	Shop Drawings				
	Qualification Data				
	Field Quality Control Reports				
<b>283111</b>	<b>Digital, Addressable Fire Alarm System</b>				
	Product Data				
	Shop Drawings				
	Qualification Data				
	Seismic Qualification Certificates				
	Field Quality Control Reports				

SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
<b>062023</b>	<b>Interior Finish Carpentry</b>							
	Maintenance Data							
084113	Aluminum Framed Entrances and Storefronts							
	Operation & Maintenance Data							
	Maintenance Data for Structural Sealant							
095113	Acoustic Panel Ceilings							
	Maintenance Data							
096519	Resilient Tile Flooring							
	Maintenance Data							
096813	Tile Carpeting							
	Maintenance Data							
097200	Wall Coverings							
	Maintenance Data							
102600	Wall and Door Protection							
	Maintenance Data							
200800	Seismic Protection							
	Maintenance Data							

SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
211313	Wet-Pipe Sprinkler Systems							
	Operation & Maintenance Data							
221119	Domestic Water Piping Specialties							
	Operation & Maintenance Data							
221319	Sanitary Waste Piping Specialties							
	Operation & Maintenance Data							
22400	Plumbing Fixtures							
	Operation & Maintenance Data							
230523	General-Duty Valves for HVAC Piping							
	Maintenance Data							
232113	Hydronic Piping							
	Maintenance Data							
233300	Air Duct Accessories							
	Operation & Maintenance Data							
239100	Variable Frequency Motor Controllers							
	Operation & Maintenance Data							

SECTION 1.E.4

OPERATING INSTRUCTIONS AND SERVICE MANUAL LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

Section	Description	Catalog Data	Wiring Diagrams	Installation Instructions	Service & Maintenance Instructions	Parts List & Availability	Performance Curves	Startup & Operating Instructions
260526	Grounding & Bonding for Electrical Systems							
260526	Operation & Maintenance Data							
260923	Lighting Control Devices							
	Operation & Maintenance Data							
262726	Wiring Devices							
	Operation & Maintenance Data							
265100	Interior Lighting							
	Operation & Maintenance Data							
280513	Conductors and Cables for Electronic Safety and Security							
	Maintenance Data							
233600	Air Terminal Units							
	Operation & Maintenance Data							

SECTION 1.E.5

CLOSEOUT LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
Project Number: CP242331  
Contractor:

<b>Section</b>	<b>Description</b>	<b>Contractor / Subcontractor</b>	<b>Date Rec'd</b>	<b># of Copies</b>	<b>CPM Initials</b>	<b>Remarks</b>
GC / 3.11	As-built drawings					
GC / 13.5.6	Final Affidavit of Supplier Diversity Participation for each Diverse firm					
<b>024119</b>	<b>Selective Demolition</b>					
	Warranties					
<b>079200</b>	<b>Joint Sealants</b>					
	Warranty Documentation					
	Special Manufacturer's Warranty					
<b>081416</b>	<b>Flush Wood Doors</b>					
	Warranties					
<b>084113</b>	<b>Aluminum-Framed Entrances and Storefronts</b>					
	Special Warranty					
	Special Finish Warranty					
<b>095113</b>	<b>Acoustical Panel Ceilings</b>					
	Furnish Extra Materials					
<b>096513</b>	<b>Wall Base and Accessories</b>					
	Furnish Extra Materials					



SECTION 1.E.5  
CLOSEOUT LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor / Subcontractor</i>	<i>Date Rec'd</i>	<i># of Copies</i>	<i>CPM Initials</i>	<i>Remarks</i>
<b>096519</b>	<b>Resilient Tile Flooring</b>					
	Furnish Extra Materials					
<b>096813</b>	<b>Tile Carpeting</b>					
	Furnish Extra Materials					
	Special Warranty for Carpet Tiles					
<b>099123</b>	<b>Interior Painting</b>					
	Furnish Extra Materials					
<b>101419</b>	<b>Dimensional Letter Signage</b>					
	Special Warranty					
<b>200800</b>	<b>Seismic Protection</b>					
	Furnish Extra Materials					
<b>211313</b>	<b>Wet-Pipe Sprinkler Systems</b>					
	Furnish Extra Materials					
<b>224000</b>	<b>Plumbing Fixtures</b>					
	Warranty					
	Furnish Extra Materials					
<b>232113</b>	<b>Hydronic Piping</b>					
	Maintenance Stock					

SECTION 1.E.5  
CLOSEOUT LOG

Project: Chemistry Building – 1<sup>st</sup> Floor Renovation  
 Project Number: CP242331  
 Contractor:

<i>Section</i>	<i>Description</i>	<i>Contractor / Subcontractor</i>	<i>Date Rec'd</i>	<i># of Copies</i>	<i>CPM Initials</i>	<i>Remarks</i>
<b>233300</b>	<b>Air Duct Accessories</b>					
	Furnish Extra Materials					
<b>262726</b>	<b>Wiring Devices</b>					
	Furnish Extra Materials					
<b>265100</b>	<b>Interior Lighting</b>					
	Warranties					
	Special Warranty for LED Drivers					
<b>283111</b>	<b>Digital, Addressable Fire Alarm System</b>					
	Software & Firmware Operational Documentation					
	Furnish Extra Materials					

## SECTION 1.F

### INDEX OF DRAWINGS

Drawings referred to in and accompanying Project Manual consists of following sheets dated September 26, 2024.

G000	COVER SHEET
G001	GENERAL INFORMATION
G002	LIFE SAFETY PLAN / CODE ANALYSIS
D101	1ST FLOOR DEMOLITION PLAN – BASE BID
D101.1	1ST FLOOR DEMOLITION PLAN – ALTERNATES
D401	1ST FLOOR DEMOLITION CEILING PLAN – BASE BID
D401.1	1ST FLOOR DEMOLITION CEILING PLAN – ALTERNATES
D800	DEMOLITION PHOTOGRAPHS
D801	DEMOLITION PHOTOGRAPHS
A001	WALL TYPES
A101	1ST FLOOR PLAN – BASE BID
A101.1	1ST FLOOR PLAN – ALTERNATES
A401	1ST FLOOR CEILING PLAN – BASE BID
A401.1	1ST FLOOR CEILING PLAN – ALTERNATES
A420	CEILING DETAILS
A600	FINISH SCHEDULE & BASE BID INTERIOR ELEVATIONS
A601	BASE BID INTERIOR ELEVATIONS & DETAILS
A602	ALTERNATES INTERIOR ELEVATIONS & DETAILS
A603	INTERIOR DETAILS
A610	BASE BID CASEWORK PLAN & DETAILS
A611	BASE BID CASEWORK ELEVATIONS
A612	BASE BID CASEWORK PLAN & DETAILS
A613	BASE BID CASEWORK DETAILS
A614	ALTERNATE #3 CASEWORK DETAILS
A615	ALTERNATE #3 CASEWORK DETAILS
A700	DOOR SCHEDULE & TYPES
M000	HVAC COVERSHEET
ME200	BASEMENT PLANS – VENTILATION AND ELECTRICAL
P101	LEVEL 01 DEMOLITION PLAN – PLUMBING
P201	LEVEL 01 PLAN – PLUMBING
P201.1	LEVEL 01 PLAN – PLUMBING – ALTERNATES
M101	LEVEL 01 DEMOLITION PLAN – PIPING
M111	LEVEL 01 DEMOLITION PLAN – VENTILATION
M111.1	LEVEL 01 DEMOLITION PLAN – VENTILATION – ALTERNATES
M211	LEVEL 01 PLAN – VENTILATION
M211.1	LEVEL 01 PLAN – VENTILATION – ALTERNATES
M400	HVAC DETAILS
M401	TEMPERATURE CONTROL DETAILS
ME600	PLUMB & VENT SCHEDULES

E000	ELECTRICAL COVERSHEET
E101	LEVEL 01 DEMOLITION PLAN – LIGHTING
E101.1	LEVEL 01 DEMOLITION PLAN – LIGHTING – ALTERNATES
E111	LEVEL 01 DEMOLITION PLAN – POWER AND SYSTEMS
E111.1	LEVEL 01 DEMOLITION PLAN – POWER AND SYSTEMS – ALTERNATES
E201	LEVEL 01 PLAN – LIGHTING
E201.1	LEVEL 01 PLAN – LIGHTING – ALTERNATES
E211	LEVEL 01 PLAN – POWER AND SYSTEMS
E211.1	LEVEL 01 PLAN – POWER AND SYSTEMS – ALTERNATES
E400	ELECTRICAL DETAILS
E600	ELECTRICAL SCHEDULES

**END OF SECTION**

SECTION 1.G

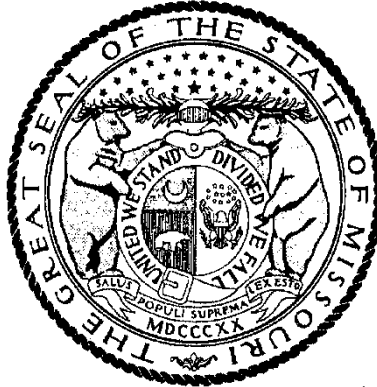
PREVAILING WAGE RATES

1. The prevailing wage rates for Boone County as issued by the Missouri Division of Labor on the following pages.

# Missouri

## Division of Labor Standards

### WAGE AND HOUR SECTION



MICHAEL L. PARSON, Governor

# Annual Wage Order No. 31

Section 010  
**BOONE COUNTY**

In accordance with Section 290.262 RSMo 2000, within thirty (30) days after a certified copy of this Annual Wage Order has been filed with the Secretary of State as indicated below, any person who may be affected by this Annual Wage Order may object by filing an objection in triplicate with the Labor and Industrial Relations Commission, P.O. Box 599, Jefferson City, MO 65102-0599. Such objections must set forth in writing the specific grounds of objection. Each objection shall certify that a copy has been furnished to the Division of Labor Standards, P.O. Box 449, Jefferson City, MO 65102-0449 pursuant to 8 CSR 20-5.010(1). A certified copy of the Annual Wage Order has been filed with the Secretary of State of Missouri.

Original Signed by \_\_\_\_\_

Todd Smith, Director  
Division of Labor Standards

Filed With Secretary of State: \_\_\_\_\_ **March 8, 2024**

Last Date Objections May Be Filed: **April 8, 2024**

Prepared by Missouri Department of Labor and Industrial Relations

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Asbestos Worker	\$61.30
Boilermaker	\$32.35*
Bricklayer-Stone Mason	\$55.22
Carpenter	\$51.42
Lather	
Linoleum Layer	
Millwright	
Pile Driver	
Cement Mason	\$45.65
Plasterer	
Communication Technician	\$57.87
Electrician (Inside Wireman)	\$58.36
Electrician Outside Lineman	\$32.35*
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Elevator Constructor	\$32.35*
Glazier	\$65.64
Ironworker	\$69.98
Laborer	\$43.79
General Laborer	
First Semi-Skilled	
Second Semi-Skilled	
Mason	\$59.96
Marble Mason	
Marble Finisher	
Terrazzo Worker	
Terrazzo Finisher	
Tile Setter	
Tile Finisher	
Operating Engineer	\$65.05
Group I	
Group II	
Group III	
Group III-A	
Group IV	
Group V	
Painter	\$41.79
Plumber	\$72.46
Pipe Fitter	
Roofer	\$55.00
Sheet Metal Worker	\$58.29
Sprinkler Fitter	\$65.10
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

\*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. The public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

\*\*The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title as defined in RSMo Section 290.210.

Heavy Construction Rates for  
BOONE County

Section 010

OCCUPATIONAL TITLE	**Prevailing Hourly Rate
Carpenter	\$63.45
Millwright	
Pile Driver	
Electrician (Outside Lineman)	\$80.19
Lineman Operator	
Lineman - Tree Trimmer	
Groundman	
Groundman - Tree Trimmer	
Laborer	\$50.35
General Laborer	
Skilled Laborer	
Operating Engineer	\$66.32
Group I	
Group II	
Group III	
Group IV	
Truck Driver	\$32.35*
Truck Control Service Driver	
Group I	
Group II	
Group III	
Group IV	

Use Heavy Construction Rates on Highway and Heavy construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(3).

Use Building Construction Rates on Building construction in accordance with the classifications of construction work established in 8 CSR 30-3.040(2).

If a worker is performing work on a heavy construction project within an occupational title that is not listed on the Heavy Construction Rate Sheet, use the rate for that occupational title as shown on the Building Construction Rate Sheet.

\*The Division of Labor Standards received fewer than 1,000 reportable hours for this occupational title. Public works contracting minimum wage is established for this occupational title using data provided by Missouri Economic Research and Information Center.

\*\*The Prevailing Hourly Rate includes any applicable fringe benefit amounts for each occupational title.



# OVERTIME and HOLIDAYS

## OVERTIME

For all work performed on a Sunday or a holiday, not less than twice (2x) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work.

For all overtime work performed, not less than one and one-half (1½) the prevailing hourly rate of wages for work of a similar character in the locality in which the work is performed or the public works contracting minimum wage, whichever is applicable, shall be paid to all workers employed by or on behalf of any public body engaged in the construction of public works, exclusive of maintenance work or contractual obligation. For purposes of this subdivision, "**overtime work**" shall include work that exceeds ten hours in one day and work in excess of forty hours in one calendar week; and

A thirty-minute lunch period on each calendar day shall be allowed for each worker on a public works project, provided that such time shall not be considered as time worked.

## HOLIDAYS

January first;  
The last Monday in May;  
July fourth;  
The first Monday in September;  
November eleventh;  
The fourth Thursday in November; and  
December twenty-fifth;

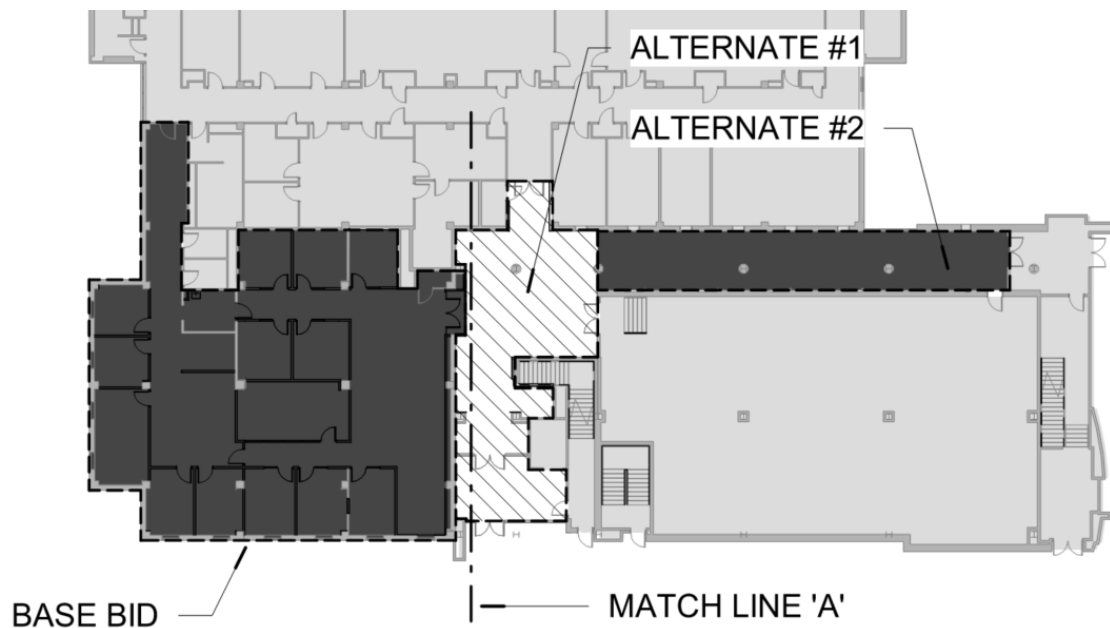
If any holiday falls on a Sunday, the following Monday shall be considered a holiday.

## SECTION 1.H

### ALTERNATES

Base Bid may be increased in accordance with following Additive Alternate proposal(s) as Owner may elect:

1. Additive Alternate No. 1: Renovate the west portion of the first floor of the interior lobby of the Chemistry Teaching Addition. This work consists of limited wall partition demolition, new finish installation, lighting and diffuser replacement, limited adjustments to the existing sprinkler heads to adapt to new ceilings, and replacement of concealed sprinkler cover plates. Life safety systems will be replaced and new power and data outlets will be provided. All as indicated on the Drawings and described in these Specifications.
2. Additive Alternate No. 2: Renovate the east portion of the first floor of the interior lobby of the Chemistry Teaching Addition. This work consists new finish installation, lighting replacement, limited adjustments to the existing sprinkler heads to adapt to new ceilings, and replacement of concealed sprinkler cover plates. Life safety systems will be replaced and new power outlets will be provided. All as indicated on the Drawings and described in these Specifications.



3. Additive Alternate No. 3: Provide (2) two new custom casework elements in the first floor of the interior lobby of the Chemistry Teaching Addition. All as indicated on the Drawings and described in these Specifications.

**END OF SECTION**

# UNIVERSITY of MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

## Hazardous Building Material Survey

Chemistry Bldg. Suite 125

CP232371

07-14-2023

**To:** Jessica Crocker  
Planning Design & Construction

**From:** Rudy Zachary  
Environmental Health & Safety

MU EHS has completed a Hazardous Building Material Survey of building materials present within Office Suite 125 of the Chemistry Building. The survey was conducted to determine the presence of Hazardous Building Materials that will be impacted by the proposed renovations to the identified areas.

This survey was conducted by Rudy Zachary (Missouri Asbestos Inspector #14679, expires 11/01/2023). This survey was also conducted to satisfy the requirements of 40CFR 61, subpart M, which stipulates that all buildings be “thoroughly inspected” for Asbestos before the commencement of renovation or demolition activities.

Asbestos containing Caulking is present on HVAC Duct sections above suspended ceiling tiles within the project area.

## Project Scope

The renovation plans calls for the potential complete reconfiguration of the existing office and conference room areas.

## Field Observations

Wall sections within the project area are comprised of both Drywall and Cinderblock wall sections. Representative samples of, Drywall, Seam Tape and Joint Compound were collected from multiple locations throughout the project area, analysis results indicate that these materials are negative for Asbestos. Ceilings throughout the project area are comprised of non-asbestos containing tiles that are suspended in a metal grid from the metal deck above. Flooring throughout the project area is carpet squares install directly onto the concrete subfloor, no residual mastic was detected in inspection areas. Vinyl Cove base is present within the project areas analysis of the brown Cove Base adhesive identified the material as being negative for Asbestos.



## Field Observations Continued

Plumbing lines above suspended ceiling tiles have Fiberglass along straight sections and Hard Mud insulation on elbows and connectors. Electrical lines above suspended ceiling tiles are mostly contained within metal conduit with the exception of IT lines. Lines are currently energized no samples were collected. HVAC Duct above suspended ceiling sections are metal with Fiberglass insulation present on exterior of duct sections.

Inspection of duct sections did reveal three different colors of caulking present, both the tan/light brown and the gray caulking both tested negative for Asbestos. **Dark brown caulking present on Duct sections tested positive for Asbestos.**

## Sample Information

Sample Number	Description	Analysis Results
230710-01-Drywall	Drywall Seam Sample Demo Wall Section Room 125	Negative for Asbestos
230710-01-Joint Compound	Drywall Seam Sample Demo Wall Section Room 125	Negative for Asbestos
230710-02	Tan Caulk Sample from HVAC Duct Room 125	Negative for Asbestos
230710-03	Gray Caulk Sample from HVAC Duct Room 125	Negative for Asbestos
230710-04	Debris on Ceiling Tiles Room 125	Negative for Asbestos
230710-05	Debris from Damaged Elbow Room 125	Negative for Asbestos
230710-06	Gray Duct Tape Sample from HVAC Duct Sections	Negative for Asbestos
230710-07	Brown Caulk on HVAC Duct Room 125I	<b>Positive for Asbestos</b> <ul style="list-style-type: none"><li>• 2% Chrysotile</li></ul>
230710-08	Black Tar Debris on Ceiling Tiles Room 125I	Negative for Asbestos
230710-09-Drywall	Drywall Seam Sample Demo Wall Exterior of Room 125C	Negative for Asbestos
230710-09-Joint Compound	Drywall Seam Sample Demo Wall Exterior of Room	Negative for Asbestos
230710-10	Plaster Finish Coat on Cinder Block Wall Section Room 125C	Negative for Asbestos
230710-11	Brown Adhesive on Drywall Sections Room 125D	Negative for Asbestos
230710-12-Drywall	Drywall Seam Sample Demo Wall Section Exterior Room 125B	Negative for Asbestos
230710-12-Joint Compound	Drywall Seam Sample Demo Wall Section Exterior Room 125B	Negative for Asbestos
230710-13-Plaster	Mixed Debris beneath Radiant Heating Unit Room 125A	Negative for Asbestos



### Sample Information Continued

Sample Number	Description	Analysis Results
230710-13-Insulation	Mixed Debris beneath Radiant Heating Un Room 125A	Negative for Asbestos
230710-13-Caulk	Mixed Debris beneath Radiant Heating Un Room 125A	Negative for Asbestos
230710-14	Brown Cove Base Adhesive Debris Room 125D	Negative for Asbestos

### Historical Sample Information (Asbestos Samples Chemistry 125, P# 119445)

Sample Id	Location/Description	Analysis Results
110503-01	125/3" mud joint	Contains no asbestos
110503-02	125/3" mud joint	Contains no asbestos
110503-03	125/3" mud joint	Contains no asbestos
110503-04	125/3" mud joint	Contains no asbestos

Paint present on cinderblock wall sections is negative for Lead.

### Universal Hazardous Waste

The Project Area contains the following items that have been identified as Universal Hazardous Waste

- One Hundred and Ninety-eight (198ea.) Fluorescent Light bulbs
- Sixty-nine (69ea.) Ballasts



# UNIVERSITY of MISSOURI

ENVIRONMENTAL HEALTH AND SAFETY

## **Asbestos Survey**

**Chemistry Building 1st Floor Renovation**

**CP242331**

**7/30/2024**

**To:** Mark Hoerstkamp  
Planning Design & Construction

**From:** Rudy Zachary  
Environmental Health & Safety

MU EHS has completed an Asbestos Survey of the building materials present within Lobby AC100A and Corridor AC100B of the Chemistry Teaching Laboratory Addition Building. The survey was made to identify Asbestos Containing Building Materials (ACBM) which will be disturbed during the planned renovations for both areas.

This survey was generated to satisfy the requirements of 40CFR 61, subpart M, which stipulates that all buildings be “thoroughly inspected” for asbestos before the commencement of renovation or demolition activities. The asbestos inspection was conducted by Rudy Zachary (Missouri Asbestos Inspector #14679, expires 10/10/2024).

As a result of the survey, none of the building materials present within the identified areas were found to be positive for Asbestos.

## **Project Scope**

The planned renovations call for the potential installation of new wall sections within the lobby and corridor. Additional modifications may include repair or replacement of damaged Floor Tiles within the corridor.

## **Field Observations**

Wall sections within the Lobby and Corridor are a combination of Drywall and Concrete. The Ceilings within the corridor areas are non-asbestos containing tiles that are suspended in a metal grid from the deck above. The ceiling above the Lobby is comprised of Drywall panels suspended in a metal grid from the deck above. Representative samples of Drywall and Joint Compound were collected from an area above the existing Lobby for analysis, the results indicate that these materials are negative for Asbestos.



## Field Observations Continued

Flooring within the project area is comprised of mixed color 12" Floor tiles that are adhered with blonde adhesive, no residual mastic was detected beneath inspection areas. Representative samples of the 12" inch gray and 12" inch white tiles were collected from damaged tiles within the corridor, analysis results indicate that the Tiles are negative for Asbestos. Debris from spray on Fireproofing & white sealant were collected off the backs of the suspended Ceiling tiles, analysis results identify the materials as being negative for Asbestos. No changes were identified within the project scope for Plumbing lines above the suspended Ceiling Tiles, lines were not inspected. Electrical lines are mostly contained within metal conduit above suspended Ceiling Tiles except for some It lines, all lines are currently energized no samples were collected.

## Sample Information

Sample Number	Description and Location	Analysis Results
240723-01	12" white floor tile debris sample corridor AC100B	Negative for Asbestos
240723-02	12" gray floor tile debris sample corridor AC100B	Negative for Asbestos
240723-03	Sample of drywall from ceiling above lobby AC100A	Negative for Asbestos
240723-04	White sealant debris on suspended ceiling tiles Corridor AC100B	Negative for Asbestos
240723-05	Gray spray on fireproofing debris on suspended ceiling tiles corridor AC100B	Negative for Asbestos
240723-06	Joint compound debris sample from ceiling above lobby AC100A	Negative for Asbestos
240723-07	24"X48" ceiling tile debris sample AC100B	Negative for Asbestos
240723-08	Seam tape debris sample from ceiling above lobby AC100A	Negative for Asbestos
240723-09	White filler on metal panels next to the suspended ceiling tiles in corridor AC100B	Negative for Asbestos



**TECHNICAL SPECIFICATIONS -  
UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL**

For

**UNIVERSITY OF MISSOURI**

**PROJECT CP242331**

**Chemistry Suite 125**

Prepared for

**UNIVERSITY OF MISSOURI**

**Campus Facilities**

**Columbia, Missouri 65211**

Prepared by

**UNIVERSITY OF MISSOURI**

**ENVIRONMENTAL HEALTH & SAFETY**



## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

### SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND Disposal

#### PART 1 - GENERAL

Provisions of the General Conditions and Special Conditions are part of this Division.

#### 1.1 WORK COVERED BY CONTRACT DOCUMENTS

1.1.1 The Contractor shall inform him/herself of the conditions for the project, and is responsible for verifying the quantities and location of all work to be performed as outlined in this section. Failure to do so shall not relieve the Contractor of his obligation to furnish all materials and labor necessary to carry out the provisions of the Contract. The work of the Contract can be summarized as follows:

The work consists of the proper removal of the following approximate quantities of hazardous materials from the Chemistry Building Office Suite 125:

##### Demolition/Construction Waste

##### Hazardous Waste

Twenty-six square feet of Asbestos containing Floor Tiles and associated black Mastic within room 125K

Brown Caulking present on HVAC Duct Sections.

##### Universal Waste

One Hundred and Ninety-eight (198ea.) Fluorescent Light bulbs,  
Sixty-nine (69ea.) Ballasts

##### Reclaim/Recycle

NA

##### Building Materials Painted with Regulated Heavy Metals

NA

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

### 1.2 **CODES AND REGULATIONS:**

1.1.2.1 All applicable codes, regulations, standards, statutes, laws, and rules have the same force and effect (and are made a part of the contract documents by reference) as if copied directly into the contract documents, or as if published copies are bound herewith. Where conflicts arise, the most stringent specification shall apply.

1.1.2.2 Federal and State requirements which govern universal and hazardous removal work or hauling and disposal of such waste materials include but are not limited to the following:

1.1.2.2.1 U.S. Department of Labor, Occupational Health and Safety Administration (OSHA), 29 CFR 1910 and 29 CFR 1926.

1.1.2.2.1.1 Construction Industry - 29 CFR 1926.1101

1.1.2.2.1.2 Respiratory Protection – 29 CFR 1910.134

1.1.2.2.1.3 Hazard Communication – 29 CFR 1910.1200

1.1.2.2.1.4 Accident Prevention Signs – 29 CFR 1910.145

1.1.2.2.2 U.S. Environmental Protection Agency (EPA)

#### 1.1.2.2.1.5 1.1.3 **CONTRACTOR'S DUTIES**

1.1.3.1 Except as specifically noted, provide and pay for:

- Labor, materials, and equipment.
- Tools, construction equipment, and machinery.
- Other facilities and services necessary for proper execution and completion of work.

1.1.3.2 Pay legally required sales, consumer, use, payroll, privilege and other taxes. Retail sales tax shall not be included in the bid amount.

1.1.3.3 Secure and pay for, as necessary for proper execution and completion of work, and as applicable at the time of bids:

- Permits
- Government Fees
- Licenses
- Except where specifically noted, provide and pay for waste disposal permits and costs

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

1.1.3.4 Give required notices.

1.1.3.5 Contractor shall assume full responsibility and liability for compliance with all codes, ordinances, rules, regulations, orders and other legal requirements of Local, State, and Federal public authorities including Environmental Protection Agency (EPA) regulations, Missouri Department of Natural Resources (MDNR) and Occupational Safety and Health Administration (OSHA) which bear on performance work. Where conflicts occur between these specifications and/or the above-mentioned regulations, the more stringent shall govern. The Contractor shall hold the owner and owner's air monitoring firm harmless for failure to comply with any applicable work, hauling, safety, health, or other regulations on the part of the contractor, contractor's employees, or contractor's subcontractors.

1.1.3.6 If the Contractor observes that any of the Contract Documents are at variance therewith in any respect, he shall promptly notify MU in writing, and any necessary changes shall be accomplished by appropriate modification. It is not the Contractor's responsibility to make certain that the Contract Documents are in accordance with applicable laws, statutes, building codes and regulations. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without such notice to MU, he shall assume full responsibility therefore and shall bear all cost attributable thereto.

1.1.3.7 Enforce strict discipline and good order among employees. Do not employ unfit persons or persons not skilled in assigned task.

1.1.3.8 Comply with all applicable federal, state, and local laws regarding job discrimination and payment of prevailing wage rates for the base bid.

1.1.3.9 The use of the best available technology, procedures, and methods for preparation, execution, cleanup, disposal, and safety are absolutely required. This compliance is the sole responsibility of the abatement contractor.

1.1.3.10 Assume responsibility for the proper and safe execution of the work.

1.1.8 **COORDINATION:** The hazard remediation contractor shall be responsible for the coordination of the universal/hazardous materials removal for this project. The hazard remediation contractor shall coordinate with all other on-site contractors and all subcontractors working under separate contracts so as to facilitate the general progress of the work. Each trade shall afford all trades every reasonable opportunity for the installation of their work.

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

### 1.2 STOP WORK

1.2.1 If the Owner, or his designated representative, presents a written or verbal stop work order, immediately stop all work or that portion of the work designated. A verbal stop work order shall be confirmed by a written stop work order within 24 hours. Do not commence referenced work until authorized in writing by the Owner or his representative.

### 1.3 CONTRACTOR USE OF PREMISES

1.3.1 **GENERAL:** During the construction period for the building, the hazard remediation will have full access to the Chemistry Building for construction operations.

1.3.2 **USE OF THE SITE:** Confine operations at the site to the areas permitted under the Contract. Portions of the site beyond areas on which work is indicated are not to be disturbed. Conform to site rules and regulations affecting the work while engaged in project construction.

1.3.2.1 Keep existing driveways and entrances serving the premises clear and available to the Owner and his employees at all times.

1.3.2.2 Do not unreasonably encumber the site with materials or equipment. Confine stockpiling of materials and location of storage to areas acceptable to Owner. If additional storage is necessary, obtain and pay for such storage off-site.

1.3.2.3 Do not load structure with weight that will endanger structure.

1.3.2.4 Assume full responsibility for protection and safekeeping of products stored on premises.

1.3.2.5 Move any stored products which interfere with operations of Owner or other contractors.

1.3.2.6 Contractor personnel shall utilize only those entrances/exits and parking lots designated by the Owner.

1.3.2.7 Contractor shall utilize only those areas designated by the Owner for the storage of equipment and the placement of dumpsters/transport containers.

1.3.2.8 Take all cautions necessary to ensure there is no universal and hazardous material contamination to those areas not included in work schedule. Should areas outside the work area become contaminated with hazardous materials, the Contractor shall immediately clean them utilizing the wet cleaning and HEPA vacuum methods specified herein. The hazard remediation contractor is responsible for the proper cleanup of all items in the work areas to maintain a clean and safe environment.

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

1.3.3 **CONTRACTOR'S USE OF THE EXISTING BUILDING**: Maintain the existing building in a safe and weather tight condition throughout the construction period. Take all precautions necessary to protect the building and its occupants during the construction period.

1.3.3.1 Keep areas such as walkways and stairs free from accumulation of waste material, rubbish or construction debris.

1.3.3.2 Smoking or open fires are prohibited within the building or on the premises.

### 1.4 OWNER OCCUPANCY

1.4.1 **PARTIAL OWNER OCCUPANCY**: The Owner reserves the right to occupy areas of the building in which universal/hazardous waste removal has been completed, provided that such occupancy does not substantially interfere with completion of the work. The Owner also reserves the right to occupy portions of the building not involved in this Scope of Work. Such partial occupancy shall not constitute acceptance of the work or any part of the work. The Owner shall also maintain the right to access areas where no universal and Hazardous waste work is being performed.

### 2.1 SUBMITTAL REQUIREMENTS

2.1.1 The following will be submitted by the contractor prior to commencement of work for approval by Owner's Certified Industrial Hygienist (one copy for the Owner's Representative). The Owner's C.I.H. will return reviewed copies to contractor and Owner's Representative.

2.1.1.1 One copy of any Safety Data Sheets (SDS) for products to be used by the contractor in the performance of his work. Contractor will also maintain copies of SDS on site per OSHA.

2.1.2 Submit the following for all Supervisor(s) and Workers who will be on the project site prior to commencement of work:

2.1.2.1 A list of project personnel and contact phone numbers

2.1.2.2 Current training certificates, if applicable

2.1.2.3 Physician's Statement that each person is physically fit to wear a respirator, if respirator use is required

2.1.2.4 Respirator Fit Test, if respirator use is required

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

- 2.1.3 Submit a detailed plan of the procedures proposed for use in complying with requirements of this specification. Include in the plan the layout and location of work areas, route of ingress and egress for the work areas, methods used to assure safety of building occupants and visitors, method of removal of material, and disposal container requirements for lead based paint material to be disposed.
- 2.1.4 Proposed disposal site for lead-based paint materials, including a disposal plan to detail type of disposal container, method of transportation to disposal site, and waste hauler.
- 2.1.5 Any other submittals as required by MU.
- 2.1.6 Upon completion of the universal/hazardous material removal, submit to the Owner's Representative, copies of hazardous materials shipping records, disposal receipts, incineration documentation, etc. for all hazardous materials removed from the project site.
- 2.1.7 Upon completion of the universal waste/hazardous material removal, the following information shall be submitted by the Owner's C.I.H. to the contractor:
  - 2.1.7.1 Construction and demolition waste landfill receipts, disposal receipts, truck tickets, incineration/recycling receipts and documentation.
  - 2.1.7.2 Written visual certification from the Owner's Certified Industrial Hygienist that universal waste/hazardous material have been removed from the facility.

### 2.2 TERMINOLOGY (Definitions)

- 2.2.1 **APPROVED Construction and Demolition WASTE DISPOSAL SITE:** A permitted solid waste landfill that is authorized by the Missouri Department of Natural Resources to receive construction and demolition wastes.
- 2.2.2 **AUTHORIZED VISITOR:** The Building Owner, the Building Owner's representative, MU personnel, or a representative of any regulatory or other agency having jurisdiction over the project.
- 2.2.3 **BARRIER:** Any surface that seals off the work area to non-authorized personnel from entering the work area.
- 2.2.4 **BUILDING OWNER:** A representative of the University of Missouri.
- 2.2.5 **DISPOSAL CONTAINER:** A properly labeled container for universal/hazardous materials. The proposed disposal container for lead-based paint will be provided to the Owner's Representative and part of the hazard remediation contractor's pre-work
- 2.2.6 **HEPA VACUUM EQUIPMENT:** High efficiency particulate air filtered vacuuming equipment with a filter system capable of collecting and retaining hazardous particulates. Filters should be of 99.97% efficiency for retaining particulates greater than 0.3 microns.

## **SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL**

**2.2.7 ON-SITE REPRESENTATIVE:** MU's full-time representative responsible for air monitoring and enforcement of the specifications.

**2.2.8 OWNER'S CERTIFIED INDUSTRIAL HYGIENIST (C.I.H.):** An Industrial Hygienist, certified in comprehensive practice by the American Board of Industrial Hygiene (ABIH).

**2.2.9 HAZARDOUS MATERIAL SHIPMENT RECORD/DISPOSAL RECEIPT:** The shipping document, required to be originated and signed by the waste generator, used to track and substantiate the disposition of universal/hazardous materials.

**2.2.10 WET CLEANING/WIPING:** The process of eliminating contamination from building surfaces and objects by using cloths, mops, or other cleaning tools which have been dampened with water, and by afterwards disposing of these cleaning tools as necessary.

**2.2.11 WORK AREA:** A specific isolated area in which universal/hazardous waste materials are required to be handled. The area is designated as a work area from the time that the area is secured and access restrictions are in place. The area remains designated as a work area until the time that it has been cleaned in accordance with any requirements applicable to the operations conducted.

### **2.3 EXISTING CONDITIONS**

**2.3.1** Building Owner and Contractor shall agree on building conditions prior to commencement of work. It shall be the Contractor's responsibility to replace or repair to the Owner's satisfaction, prior to close-out of the project, all damaged items caused by the Contractor and not proven otherwise. All items damaged prior to remediation shall be noted during preconstruction walk-through.

### **3.1 PERSONNEL PROTECTION REQUIREMENTS**

**3.1.1** Prior to commencement of work, the workers shall be instructed and shall be knowledgeable on the hazards of the universal hazardous materials involved and other environmental exposures, use and fitting of respirators, protective clothing, decontamination procedures, and all aspects of remediation work procedures; workers shall have medical examinations.

**3.1.2** The Contractor acknowledges that he alone is responsible for enforcing personnel protection requirements and that these specifications provide only a minimum acceptable standard for each phase of operation.

**3.1.3** If required or requested of the workers, provide workers with personally issued and marked respiratory equipment approved by NIOSH and accepted by OSHA.

**3.1.4** No visitors shall be allowed in work areas, except as authorized.

**3.1.5** Where required or if requested by the workers, provide workers with sufficient sets of disposable protective full-body clothing. Such clothing shall consist of full-body coveralls, footwear, and head gear, one-piece coveralls or equal. Provide eye protection and hard hats as required by applicable safety regulations. Disposable clothing shall not be allowed to accumulate and shall be disposed of as contaminated waste.

**3.1.6** Provide authorized visitors with suitable protective clothing, headgear, footwear, and gloves as described above whenever they are required to enter the work area.

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

### 3.2 MATERIALS

3.2.1 Deliver all materials in the original packages, containers, or bundles bearing the name of the manufacturer and the brand name.

3.2.1.1 Store all materials subject to damage off the ground, away from wet or damp surfaces, and under cover sufficient to prevent damage or contamination.

3.2.1.2 Damaged or deteriorating materials shall not be used and shall be removed from the premises.

3.2.2 **PLASTIC SHEETING:** A minimum 6-mil (or as specified).

3.2.3 **TAPE:** Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheets to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water, duct tape, poly prep tapes or approved equal.

3.2.4 **ADHESIVES:** Capable of sealing joints of adjacent sheets of polyethylene and for attachment of polyethylene sheet to finished or unfinished surfaces of dissimilar materials and capable of adhering under both dry and wet conditions, including use of amended water.

3.2.5 **IMPERMEABLE CONTAINERS:** Suitable to receive and retain any hazardous materials until disposal by the owners rep. The containers shall be labeled as required by owner. Containers must be resistant to damage and rupture.

3.2.6 **WARNING LABELS AND SIGNS:** As required by owner.

3.2.7 **OTHER MATERIALS:** Provide all other materials, such as, but not limited to lumber, plywood, nails, and hardware, which may be required to properly prepare and complete this project.

### 3.3 TOOLS AND EQUIPMENT

3.3.1 Provide suitable tools for universal/hazardous waste removal and disposal.

3.3.1.1 Water Sprayer: Airless or a low pressure sprayer for amended water application as applicable.

3.3.1.2 Air-Purifying Equipment: High Efficiency Particulate Air Filtration Systems (HEPA) shall comply with ANSI Z9.2-91. No air movement system or air equipment should discharge particulates outside the work area. Thus, the negative air unit shall be equipped with a three-filter bank with the last being the HEPA filter capable of removing 99.97% of fibers/particulates >0.3 microns.

3.3.1.3 Scaffolding: As required to accomplish the specified work and meet all applicable safety regulations.

2.3.1.4 Vacuums: Use HEPA type from a known manufacturer.

2.3.1.5 Other tools and equipment as necessary.



## **SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL**

### **3.4 SUPERVISION OF UNIVERSAL/HAZARDOUS Material REMOVAL**

3.4.1 The contractor shall designate a competent supervisor subject to the approval of the Owner's C.I.H. and the Owner's Representative. The supervisor shall be the Contractor's representative on the project, shall meet the requirements of all applicable regulations, and perform or meet the following minimum requirements:

3.4.1.1 Be knowledgeable in all aspects of removal, cleanup and proper disposal of universal hazardous materials as listed in the Scope of Work.

3.4.1.2 Be onsite and supervise all removal, cleanup and disposal activities.

3.4.1.3 Maintain a daily log on the project documenting events, violations, problems, equipment failures, accidents, and inspections.

3.4.1.4 Be responsible for implementation of first aid, safety training, respiratory protection, and ensuring all workers are trained in emergency procedures.

3.4.1.5 Be responsible for conducting a visual inspection of the work area prior to a visual inspection by the Owner's Certified Industrial Hygienist. Inspection shall be documented.

### **3.5 WORKER PROTECTION / TRAINING**

3.5.1 The contractor shall be responsible for providing his employees with proper respiratory protection, respiratory training, a written respirator program, medical examinations, maintaining medical records, protective clothing and equipment to comply with OSHA requirements, if necessary

3.5.2 All workers shall be trained in the dangers inherent in handling universal waste, and hazardous materials, in proper work procedures, and personal protective measures.

### **3.6 OWNER'S CERTIFIED INDUSTRIAL HYGIENIST**

3.6.1 It will be the Owner's responsibility to hire a Certified Industrial Hygienist. The Certified Industrial Hygienist will also be required to perform the following duties as a minimum:

3.6.1.1 Approval of the Contractor's work plan and methods of remediation to meet regulatory requirements and ensure the health and safety of University faculty, staff, and students.

3.6.1.2 Verify that the Contractor is satisfactorily performing the work in accordance with OSHA regulations.

3.6.1.3 Visual inspection of the work areas.

3.6.1.4 Certify in writing that the Contractor's procedures, methods, and practices were, to the best of his/her knowledge and belief, in compliance with current EPA, OSHA, State, and Local applicable regulations, that the work areas meet the requirements for a final visual inspection prior to re-occupancy, and an accounting of any known deviations.

### **3.7 SEPARATION OF WORK AREAS FROM NONWORK AREAS**

3.7.1 Visual separation shall be accomplished at all "see-through" locations using opaque polyethylene. This separation shall not be incorporated within the other seals involved on this project.

## **SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL**

### **3.8 EMERGENCY PROTECTION PLAN / FIRE EXITS**

3.8.1 The contractor shall be responsible for developing a written Emergency Protection Plan and shall maintain this plan onsite. The plan shall include considerations of fire, explosion, toxic atmospheres, electrical hazards, slips, falls, and heat related injury. All employees shall be instructed and trained in the procedures.

3.8.2 The Emergency Protection Plan shall also include written notification of police, fire, and medical personnel of the planned remediation activities, work schedule, and layout of the work area, particularly barriers that may affect response capabilities.

3.8.3 Designate and maintain emergency and fire exits from the work area in accordance with local codes and regulations. All exits shall be clearly marked with fluorescent tape or red paint and shall be clearly visible from any part of the work area.

### **3.9 LOCAL AREA PROTECTION / SITE SECURITY**

3.9.1 The contractor shall secure the work areas to make sure of no inadvertent entry. Any breach to the exterior of the building shall be secured by the hazard remediation contractor. The Contractor shall be responsible for maintaining security of the remediation areas throughout the contract period.

3.9.2 The contractor shall be responsible for all areas of the building used by contractor and/or subcontractors in the performance of the work. Contractor shall exert full control over the actions of all employees and other persons with respect to the use and preservation of the existing building, except such controls as may be specifically reserved to the owner.

3.9.3 Contractor has the right to exclude from the work area all persons who have no purpose related to the work or its inspection, and shall require all persons in the work area to observe the same regulations required of Contractor's employees.

3.9.4 The contractor shall have control of site security during remediation operations in order to protect the work environment and equipment. Contractor shall have the owner's assistance in notifying building occupants of impending activity and enforcement of restricted access by owner's employees.

3.9.5 The contractor shall keep a minimum of two (2) 10lb type ABC fire extinguishers onsite. One shall be maintained outside the work area and one inside each work area. Contractor employees shall be trained in the operation of fire extinguishers.

3.9.6 The contractor shall maintain the work area free from rubbish, debris, and dirt, and keep a clean, safe working area.

### **3.10 UNIVERSAL WASTE/HAZARDOUS MATERIALS REMOVAL OPERATIONS**

3.10.1 Any light fixtures, housings, etc. concealing items considered to be universal waste/hazardous material shall be removed, containerized, labelled, and left on site for disposal by MU EHS. This does not include refrigerant or CHC/HCFC-containing equipment which are being replaced by the contractor. It does not include TCLP ceramic tile, which should be handled by the contractor.

#### **3.10.2 MATERIALS PAINTED WITH RCRA-Metals PAINT –**

It is anticipated that these items will be removed as part of the demolition process and will be segregated from the remainder of the demolition debris. It is anticipated that these items will be hauled away and disposed of in a sanitary landfill approved by the State of Missouri to accept construction and demolition waste. These areas should be sealed off with polyethylene

## SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL

sheeting over the doors, vents, windows, or any other openings into/out of the area.

- 3.10.3 **FLUORESCENT LIGHT TUBES** may contain small amounts of Mercury. This can potentially be harmful to human health and the environment. The bulbs should be placed in fiberboard boxes provided by MU EHS to minimize breakage. MU EHS will manage disposal of this material.
- 3.10.4 **POLYCHLORINATED BIPHENYL (PCBS)** are a known carcinogenic material. Its use was discontinued January 1, 1979. Due to the age of the building, it should be assumed that any ballast can contain PCBs unless it is labeled as PCB free by the manufacturer. Due to this, any light ballasts presumed to contain PCBs should be properly disposed of. MU Environmental Health Safety will provide collection container for this purpose. Non-PCB ballasts will also be managed by MU Environmental Health Safety. Collection containers will be provided to the contractor upon their request.
- 3.10.5 **SMOKE DETECTORS** are typically ionization smoke detectors that may contain a small amount of radioactive material. MU Environmental Health and Safety will provide collection containers for this material and will also be responsible for the disposal of this material.
- 3.10.6 **FIRE ALARMS (STROBE LIGHT)** are typically not considered a universal or hazardous waste. However, for the purposes of this project, these items should be collected by the contractor and managed by MU Environmental Health and Safety. Collection containers will be provided to the contractor upon their request.
- 3.10.7 **EXIT SIGNS AND EMERGENCY LIGHTS** typically have backup batteries that may contain small amounts of lead. Some exit signs are powered by a small amount of radioactive material. Powered exit signs and emergency lights should have the battery removed and disposed of by MU Environmental Health and Safety. Non powered exit signs should be assumed to contain radioactive material and should be collected for disposal via MU Environmental Health and Safety. MU Environmental Health and Safety will provide collection containers for these items.
- 3.10.8 **DRINKING FOUNTAINS:** Some drinking fountains have reservoirs that may contain lead and a CFC/HCFC refrigerant that must be recovered. The lead reservoirs should be removed and recycled. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.
- 3.10.9 **DOOR CLOSURES:** Some of the older door closures have oil reservoirs for lubrication. These oils may contain small amounts of PCBs. MU Environmental Health and Safety will provide a collection container for this material, and will be responsible for disposal.
- 3.10.10 **THERMOSTATS** may contain Mercury. This can potentially be harmful to human health and the environment. Mercury containing thermostats shall be disposed of as a hazardous waste. MU EHS will provide a collection container for this material, and will be responsible for disposal.
- 3.10.11 **WINDOW AIR CONDITIONING UNITS:** Where possible, these window units should be removed and stored for use elsewhere. Otherwise these units may contain CFC/HCFC refrigerants that must be recovered. CFC/HCFC refrigerants are suspected to damage the atmosphere. The CFC/HCFC refrigerant must be recovered by a contractor licensed and trained in this type of work. The remainder of the unit should be managed as scrap metal.

## **SECTION 020810 – UNIVERSAL/HAZARDOUS MATERIALS REMOVAL AND DISPOSAL**

3.10.12 **CERAMIC TILE:** are made from clay bodies that contain high concentrations of silica.

Respirable crystalline silica is a “known human carcinogen.” When ceramic tiles are cut, abraded, shattered, or crushed, hazardous silica dust can be generated. Ceramic tiles can also have high concentrations of toxic metals, in the clay body and in the glazing, and potentially be classified as Hazardous Waste.

### **3.12 REESTABLISHMENT OF THE WORK AREA**

3.1 2.1 Reestablishment of the work area shall only occur after the Contractor has received a final visual inspection from the Owner’s C.I.H. documenting that the universal/hazardous waste materials have been removed from the project site.

**END OF SECTION**

SECTION 024119 - SELECTIVE DEMOLITION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

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

1.2 DEFINITIONS

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

1.3 MATERIALS OWNERSHIP

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

1.4 INFORMATIONAL SUBMITTALS

- A. Proposed Protection Measures: Submit report, including Drawings, that indicates the measures proposed for protecting individuals and property, for dust control, and for noise control. Indicate proposed locations and construction of barriers.
- B. Schedule of Selective Demolition Activities: Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
  2. Interruption of utility services. Indicate how long utility services will be interrupted.
  3. Coordination for shutoff, capping, and continuation of utility services.
  4. Use of elevator and stairs.
  5. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- C. Predemolition Photographs or Video: Show existing conditions of adjoining construction, including finish surfaces, that might be misconstrued as damage caused by salvage and demolition operations. Submit before Work begins.
- D. Warranties: Documentation indicating that existing warranties are still in effect after completion of selective demolition.

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. AV Equipment.
    - b. Loose Furniture.
    - c. Wall plaques.
    - d. Vending machines.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Present in buildings and structures to be selectively demolished. A report on the presence of hazardous materials is on file for review and use. Examine report to become aware of locations where hazardous materials are present.
1. Hazardous materials remediation is specified elsewhere in the Contract Documents.
  2. Do not disturb hazardous materials or items suspected of containing hazardous materials except under procedures specified elsewhere in the Contract Documents.
  3. Owner will provide material safety data sheets for suspected hazardous materials that are known to be present in buildings and structures to be selectively demolished because of building operations or processes performed there.
- E. Storage or sale of removed items or materials on-site is not permitted.
- F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.
1. Maintain fire-protection facilities in service during selective demolition operations.

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## 1.6 COORDINATION

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review Project Record Documents of existing construction or other existing condition and hazardous material information provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in Project Record Documents.
- C. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs or video.
  - 1. Inventory and record the condition of items to be removed and salvaged.

### 3.2 PREPARATION

- A. Refrigerant: Before starting demolition, remove refrigerant from mechanical equipment according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage. Coordinate utility activity with Owner's Representative.

### 3.4 PROTECTION

- A. Temporary Protection: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
2. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
3. Cover and protect furniture, furnishings, and equipment that have not been removed.

B. Remove temporary barricades and protections where hazards no longer exist.

### 3.5 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. 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. Maintain fire watch during and for at least 24 hours after flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
8. Dispose of demolished items and materials promptly.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

C. 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.

D. 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.



- A. 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.

**3.6 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS**

- A. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, and then remove masonry between saw cuts.
- B. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.

**3.7 DISPOSAL OF DEMOLISHED MATERIALS**

- A. Remove demolition waste materials from Project site and dispose of them in an EPA-approved construction and demolition waste landfill acceptable to authorities having jurisdiction.
  - 1. Do not allow demolished materials to accumulate on-site.
  - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn demolished materials.

**3.8 CLEANING**

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

END OF SECTION 024119

SECTION 051200 – MISCELLANEOUS STRUCTURAL STEEL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Structural steel required for bench supports.

B. Related Requirements:

1. Section 099123 "Interior Painting" for painting requirements.

1.2 DEFINITIONS

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

1.3 COORDINATION

- A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. Anchor rods.
3. Threaded rods.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Indicate compliance with 2017 ICC A117.1 Section 903.6 for vertical and horizontal force of 250 pounds.

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- C. Delegated Design Submittal: Provide for structural-steel connections and supports at Casework Benches as indicated on Drawings. Include calculations signed and sealed by the qualified professional engineer, registered in the State of Missouri, responsible for their preparation.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Comply with applicable provisions of the following specifications and documents:
  - 1. ANSI/AISC 303.
  - 2. ANSI/AISC 360.
  - 3. 2017 ICC A117.1 Section 903

### 2.2 STRUCTURAL-STEEL MATERIALS

- A. Plate and Bar: ASTM A36/A36M.
- B. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

### 2.3 RODS

- A. Threaded Rods: ASTM A36/A36M.
  - 1. Nuts: ASTM A63 hex carbon steel.
  - 2. Washers: ASTM A36/A36M carbon steel.
  - 3. Finish: Hot-dip zinc coating, ASTM A153/A153M, Class C.

2.4 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.
  - 1. Camber structural-steel members where indicated.
  - 2. Mark and match-mark materials for field assembly.
- B. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 3.
- C. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
  - 1. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

PART 3 - EXECUTION

3.1 FIELD CONNECTIONS

- A. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

3.2 REPAIR

- A. Touchup Painting:
  - 1. Cleaning and touchup priming and painting are specified in Section 099123 "Interior Painting."

END OF SECTION 051200

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
  - 1. Wood blocking and nailers.
  - 2. Plywood backing panels.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
  - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
  - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

- A. Reports: For the following, from ICC-ES:
  - 1. Wood-preservative-treated wood.
  - 2. Fire-retardant-treated wood.
- B. Qualification Statements: For testing agency providing classification marking for fire-retardant treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.
- B. Maximum Moisture Content of Lumber:
  - 1. Boards: 19 percent unless otherwise indicated.

2.2 FIRE-RETARDANT TREATMENT

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  - 1. Treatment shall not promote corrosion of metal fasteners.
  - 2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
  - 1. Concealed blocking.
  - 2. Plywood backing panels.

2.3 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. Concealed Boards: 19 percent maximum moisture content and any of the following species and grades:
  - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
  - 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
  - 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
- C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.
- E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch (19-mm) nominal thickness.

2.5 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.
  - 1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M or ASTM F2329.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Wood Screws: ASME B18.6.1.

- E. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
- D. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- E. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
  - 1. Use inorganic boron for items that are continuously protected from liquid water.
  - 2. Use copper naphthenate for items not continuously protected from liquid water.
- F. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
  - 2. ICC-ES evaluation report for fastener.
- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.



3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 062023 - INTERIOR FINISH CARPENTRY

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. Plastic-laminate-faced architectural cabinets.
2. Solid-surface-material countertops and backsplashes.
3. Solid-surface-material window sills.
4. Wood veneer-faced architectural panels.
5. Wood veneer-faced panel shop finishing.
6. Solid hardwood trim.
7. Countertop support brackets.
8. Bench support brackets.
9. Upholstered cushions.
10. Casework accessories.

B. Related Requirements:

1. Section 051200 "Miscellaneous Structural Steel" for steel framing and support for benches and millwork.
2. Section 061000 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view.

1.3 DEFINITIONS

- A. MDF: Medium-density fiberboard.

1.4 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that interior architectural woodwork can be supported and installed as indicated.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
  - 1. Include data for wood-preservative treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained. Include chemical-treatment manufacturer's written instructions for finishing treated material.
  - 2. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced before shipment to Project site to levels specified.
  
- B. Shop Drawings: For interior finish carpentry.
  - 1. Include plans, elevations, sections, and attachment details.
  - 2. Show large-scale details.
  - 3. Show locations and sizes of furring, blocking, and hanging strips, including blocking and reinforcement concealed by construction and specified in other Sections.
  - 4. Show direction of directional pattern, if any.
  - 5. Apply AWI Quality Certification Program label to Shop Drawings.
  
- A. Samples for Verification:
  - 1. Plastic laminates, 8 by 10 inches, for each color, pattern, and surface finish.
  - 2. Countertop and window sill material, 6 inches square.
  - 3. Wood veneers, 10 inches square, for each color, pattern, and surface.
  - 4. Solid hardwood trim, 6 inches square, for each color, pattern, and surface.
  - 5. Upholstery fabric, 12 inches square.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
  
- B. Product Certificates: For the following:
  - 1. Composite wood and agrifiber products.
  - 2. Adhesives.
  
- C. Quality Standard Compliance Certificates: AWI Quality Certification Program.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For the following:
  - 1. For solid surface material countertops and window sills to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.
  - 2. For upholstery fabric to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and name, addresses, and telephone numbers of local sources for products.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.
  - 1. Shop Certification: AWI's Quality Certification Program accredited participant.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Do not deliver interior architectural woodwork until painting and similar finish operations that might damage woodwork have been completed in installation areas. Store woodwork in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install interior architectural woodwork until building is enclosed, wet-work is complete, and HVAC system is operating and maintaining temperature and relative humidity at levels planned for building occupants during the remainder of the construction period.
- B. Field Measurements: Where interior architectural woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
  - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurements before being concealed by construction, and indicate measurements on Shop Drawings.

1.11 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 INTERIOR FINISH CARPENTRY, GENERAL

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
  - 1. Provide inspections of fabrication and installation together with labels and certificates from AWI certification program indicating that woodwork complies with requirements of grades specified.

2. The Contract Documents contain requirements that are more stringent than the referenced quality standard. Comply with requirements of Contract Documents in addition to those of the referenced quality standard.

2.2 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Wilsonart International Holdings, Inc.
    - b. Formica Corporation.
    - c. Pionite; a Panolam Industries International, Inc. brand.
- F. Laminate Cladding for Exposed Surfaces:
  1. Horizontal Surfaces: Grade HGS.
  2. Postformed Surfaces: Grade HGP.
  3. Vertical Surfaces: Grade HGS.
  4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
  5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.
  6. Color: Formica Pencil Wood 7747 or approved equal by Architect.
- G. Laminate Cladding for Semiexposed Surfaces:
  1. Surfaces Other Than Drawer Bodies: Plastic-laminate panels.
    - a. Edges of Plastic-laminate Panel Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
    - b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
  2. Drawer Sides and Backs: Plastic-laminate panels with PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
  3. Drawer Bottoms: Plastic-laminate panels.
  4. Color: Formica Storm 912-58 or approved equal by Architect.

- H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
  - 1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

2.3 SOLID-SURFACE-MATERIAL COUNTERTOPS AND BACKSPASHES

- 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.
- B. Countertops: 3/4-inch- thick, solid surface material, unless noted otherwise in architectural drawings.
- C. Backsplashes: 1/4-inch- thick, solid surface material, unless noted otherwise in architectural drawings.
- D. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Corian, an E. I. du Pont de Nemours and Company.
    - b. Samsung Chemical USA, Inc.
    - c. Wilsonart International Holdings, Inc.
    - d. Avonite Surfaces.
  - 2. Type: Provide Standard Type unless Special Purpose Type is indicated.
  - 3. Colors and Patterns: As indicated by manufacturer's designations.
    - a. In Rooms 125L, 125M and 125Q: Corian; Ash Concrete or approved equal by Architect.
    - b. In Room 125A and 125U: Corian; Cameo White or approved equal by Architect.
- E. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

2.4 SOLID-SURFACE-MATERIAL WINDOW SILLS

- A. Sills: 1/2-inch- thick, solid surface material.
- B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

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- a. Corian, an E. I. du Pont de Nemours and Company.
      - b. Samsung Chemical USA, Inc.
      - c. Wilsonart International Holdings, Inc.
      - d. Avonite Surfaces.
    2. Type: Provide Standard Type unless Special Purpose Type is indicated.
    3. Colors and Patterns: As indicated by manufacturer's designations.
      - a. Corian; Cameo White or approved equal by Architect.
  - C. Fabrication: Fabricate in one piece unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- 2.5 SOLID-SURFACE-MATERIAL BENCH BACK SUPPORT
- A. Sills: 1/2-inch- thick, solid surface material.
  - B. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
    1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Corian, an E. I. du Pont de Nemours and Company.
      - b. Samsung Chemical USA, Inc.
      - c. Wilsonart International Holdings, Inc.
      - d. Avonite Surfaces.
    2. Type: Provide Standard Type unless Special Purpose Type is indicated.
    3. Colors and Patterns: As indicated by manufacturer's designations.
      - a. To match adjacent wall color.
  - C. Fabrication: Fabricate in one piece unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- 2.6 WOOD VENEER-CLAD ARCHITECTURAL PANELS
- A. Grade: Premium.
  - B. Wood Species and Cut: Select white maple, quarter sliced.
    1. Staining: Match Architect's sample.
  - C. Veneer Matching Method:
    1. Adjacent Veneer Leaves: Book match.
    2. Within Panel Face: Balance match.
    3. Adjacent Veneer Leaves and within Panel Face: Book match.

- D. Panel-Matching Method: Sequence-matched, uniform-size sets within each separate area.
- E. Vertical Panel-Matching Method: Continuous end match; veneer leaves of upper panels are continuations of veneer leaves of lower panels.
- F. Panel Core Construction: Hardwood veneer-core plywood.
  - 1. Thickness: 3/4 inch.
- G. Exposed Panel Edges: Inset solid-wood or wood-veneer matching faces stained to match adjacent veneer and as noted on architectural drawings.
- H. Panel Reveals: As shown in drawings.
- I. Assemble panels by back mounting z-clips and concealed fastening.
- J. Fabrication
  - 1. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.
  - 2. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 3. Shop cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
- K. Shop Finishing
  - 1. General: Finish paneling at fabrication shop as specified in this Section. Defer only final touchup, cleaning, and polishing until after installation.
  - 2. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing paneling, as applicable to each unit of work.
    - a. Backpriming: Apply two coats of sealer or primer, compatible with finish coats, to concealed surfaces of paneling.
  - 3. Transparent Finish:
    - a. Grade: Premium.
    - b. Finish: System - 5, conversion varnish.
    - c. Wash Coat for Closed-Grain Woods: Apply wash-coat sealer to woodwork made from closed-grain wood before staining and finishing.
    - d. Staining:
      - 1) Match Architect's sample.



- e. Filled Finish for Open-Grain Woods: After staining, apply wash-coat sealer and allow to dry. Apply paste wood filler and wipe off excess. Tint filler to match stained wood.
  - f. Sheen: Flat, 15-30 gloss units measured on 60-degree gloss meter per ASTM D523.
- 4.

2.7 COUNTERTOP SUPPORT BRACKETS

- A. Wall, flush mounted, heavy duty, welded steel bracket for supporting countertops.
  - 1. Basis-of-Design: Subject to compliance with requirements, provide Centerline Brackets; Front Mounting Brackets or an approved equal by Architect.
    - a. Size as recommended by manufacturer for depth of counter indicated on drawings.
  - 2. Load capacity per bracket: 300 pounds.
  - 3. Maximum spacing — 24 inches o.c.
- B. Material: Fabricate components from A36 grade steel, 3/8 inch thick by 2-1/2" wide plate with beveled ends.
- C. Finish: Paint to match adjacent surfaces.

2.8 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Nailers: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.
- B. Provide self-drilling screws for metal-framing supports, as recommended by metal-framing manufacturer.
- C. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- D. Adhesives: Do not use adhesives that contain urea formaldehyde.
- E. Installation Adhesive: Product recommended by fabricator for each substrate for secure anchorage.
  - 1. Adhesives shall have a VOC content of 70 g/L or less.
- F. Sealant for Countertops and Sills: Comply with applicable requirements in Section 079200 "Joint Sealants."
- G. Z-clip: 2-inch clip, with 1/4 inch projection and 3/8 inch lift-off.
  - 1. Manufacturer: Subject to compliance with requirements, provide Monarch Metal Fabrications; MF375.

2.9 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening.
- B. Metal Pulls:
  - 1. Basis of Design: Pull Handle – Richelieu, Modern Metal Pull 5632.
    - a. Length: 5-1/32 inches.
    - b. Finish: Matte Black.
  - 2. Basis of Design: Drop Edge Pull – Richelieu, Modern Aluminum Edge Pull 9595.
    - a. Length: 5-1/32 inches.
    - b. Finish: Brushed Black.
- C. Shelf Standards:
  - 1. Heavy Duty Standards: Richelieu; Series #82.
    - a. Finish: Black.
- D. Shelf Rests: BHMA A156.9, B04013; metal.
  - a. Finish: Black.
- E. Drawer Slides:
  - 1. Basis of Design: Knappe & Vogt, 8650 Soft Close Full Extension Slide
    - a. Capacity: 150 lb
    - b. Length: 20 in.
- F. Door Locks: BHMA A156.11, E07121.
  - a. Finish: Black.
- G. Drawer Locks: BHMA A156.11, E07041.
  - a. Finish: Black.
- H. Door and Drawer Silencers: BHMA A156.16, L03011.
- I. Adjustable Leveler:
  - 1. Manufacturer: Richelieu; Product # 30000190.
- J. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- K. Grommets for pass through cables: 2-1/2 inch OD, color as selected by Architect from manufacturer's full standard selection, metal grommets and matching metal caps with slot for wire passage.
  - 1. Basis of Design Product: Subject to compliance with requirements, provide MM6 series by Doug Mockett & Company, Inc. or comparable product.

2.10 FABRICATION

- A. Fabricate architectural cabinets to dimensions, profiles, and details indicated.
- B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.
- C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive solid surface material countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.
- B. Before installing woodwork, examine shop-fabricated work for completion and complete work as required.

3.3 INSTALLATION

- A. Grade: Install woodwork to comply with same grade as item to be installed.
- B. Assemble woodwork and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

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- D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
  - 1. Use filler matching finish of items being installed.
- F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.
- G. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.
- H. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. 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.
  - 1. Install endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
- I. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.
  - 1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- J. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- K. Install aprons to backing and countertops with adhesive. Miter countertop and apron pieces prior to applying adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Predrill holes for screws as recommended by manufacturer. Slightly ease mitered edge.
- L. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
  - 1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- M. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

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- N. Touch up finishing work specified in this Section after installation of wood trim. Fill nail holes with matching filler where exposed.

### 3.4 ADJUSTING AND CLEANING

- A. Repair damaged and defective woodwork, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean, lubricate, and adjust hardware.
- C. Clean woodwork on exposed and semiexposed surfaces.

END OF SECTION 064023

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Joint-sealants.
2. Joint sealant backing materials.

- B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranties.

1.4 CLOSEOUT SUBMITTALS

A. Warranty Documentation:

1. Manufacturers' special warranties.

1.5 FIELD CONDITIONS

- A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

- A. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
  - 1. Warranty Period: Ten years from date of Substantial Completion.
- B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
  - 1. Movement of the structure caused by stresses on sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  - 2. Disintegration of joint substrates from causes exceeding design specifications.
  - 3. Mechanical damage caused by individuals, tools, or other outside agents.
  - 4. Changes in sealant appearance caused by accumulation of dirt of other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C1248.
- B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade NS, Class 50, Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795.
    - b. Master Builders; Master Seal NP100.
    - c. Pecora Corporation; 895NST.
    - d. Tremco Incorporated; Spectrem 3.

2.3 JOINT-SEALANT BACKING

- A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

- B. Cylindrical Sealant Backings: ASTM C1330, 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.

#### 2.4 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete Masonry Units.
    - b. Limestone.
  - 3. Remove laitance and form-release agents from concrete.



4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
  - a. Metal.
  - b. Glass.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  1. Do not leave gaps between ends of sealant backings.
  2. Do not stretch, twist, puncture, or tear sealant backings.
  3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  1. Place sealants so they directly contact and fully wet joint substrates.
  2. Completely fill recesses in each joint configuration.
  3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
  1. Remove excess sealant from surfaces adjacent to joints.

2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.
  - a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.4 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.5 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.6 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement.
  1. Joint Locations:
    - a. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
    - b. Other interior joints as indicated on Drawings.
  2. Joint Sealant: Acrylic latex.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.
  1. Joint Locations:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Other joints as indicated on Drawings.
  2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 079200

SECTION 079500 – EXPANSION CONTROL

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 interior expansion joint cover assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for expansion joint cover assemblies.
- B. Shop Drawings: For each expansion joint cover assembly.
  - 1. Include plans, elevations, sections, details, splices, block-out requirement, attachments to other work, and line diagrams showing entire route of each expansion joint.
  - 2. Where expansion joint cover assemblies change planes, provide isometric or clearly detailed drawing depicting how components interconnect.
- C. Samples: For each expansion joint cover assembly and for each color and texture specified, full width by 6 inches (150 mm) long in size.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Furnish units in longest practicable lengths to minimize field splicing.
- B. Include factory-fabricated closure materials and transition pieces, T-joints, corners, curbs, cross-connections, and other accessories as required to provide continuous expansion joint cover assemblies.

2.2 WALL EXPANSION JOINT COVERS

- A. Metal-Plate Wall Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Construction Specialties, ASM Series.
  - b. Inpro, 811 Series.
2. Application: Wall to wall and wall to corner.
3. Fire-Resistance Rating: Not less than that of adjacent construction.
4. Exposed Metal:
  - a. Aluminum: Clear anodic, Class II. Refer to architectural drawings for locations required to be field painted.

### 2.3 CEILING EXPANSION JOINT COVERS

- A. Metal-Plate Ceiling Joint Cover: Metal cover plate fixed on one side of joint gap and free to slide on other.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Construction Specialties, ASM Series.
    - b. Inpro, 811 Series.
  2. Application: Ceiling to ceiling and Wall to ceiling.
  3. Fire-Resistance Rating: Not less than that of adjacent construction.
  4. Exposed Metal:
    - a. Aluminum: Clear anodic, Class II. Refer to architectural drawings for locations required to be field painted.

### 2.4 MATERIALS

- A. Aluminum: ASTM B221 (ASTM B221M), Alloy 6063-T5 for extrusions; ASTM B209 (ASTM B209M), Alloy 6061-T6 for sheet and plate.
  1. Apply manufacturer's standard protective coating on aluminum surfaces to be placed in contact with cementitious materials.

### 2.5 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

### 2.6 ACCESSORIES

- A. Manufacturer's standard attachment devices. Include anchors, clips, fasteners, set screws, spacers, and other accessories compatible with material in contact, as indicated or required for complete installations.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces where expansion joint cover assemblies will be installed for installation tolerances and other conditions affecting performance of the Work.
- B. Notify Architect where discrepancies occur that will affect proper expansion joint cover assembly installation and performance.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to expansion joint cover assembly manufacturer's written instructions.
- B. Coordinate and furnish anchorages, setting drawings, and instructions for installing expansion joint cover assemblies. Provide fasteners of metal, type, and size to suit type of construction indicated and to provide for secure attachment of expansion joint cover assemblies.

3.3 INSTALLATION

- A. Comply with manufacturer's written instructions for storing, handling, and installing expansion joint cover assemblies and materials unless more stringent requirements are indicated.
- B. Metal Frames: Perform cutting, drilling, and fitting required to install expansion joint cover assemblies.
  - 1. Repair or grout block out as required for continuous frame support using nonmetallic, shrinkage-resistant grout.
  - 2. Install frames in continuous contact with adjacent surfaces.
    - a. Shimming is not permitted.
  - 3. Install in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.
  - 4. Adjust for differences between actual structural gap and nominal design gap due to ambient temperature at time of installation.
  - 5. Cut and fit ends to accommodate thermal expansion and contraction of metal without buckling of frames.
  - 6. Locate anchors at interval recommended by manufacturer, but not less than 3 inches (75 mm) from each end and not more than 24 inches (600 mm) o.c.
- C. Install with hairline mitered corners where expansion joint cover assemblies change direction or abut other materials.
- D. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

3.4 PROTECTION

- A. Do not remove protective covering until finish work in adjacent areas is complete. When protective covering is removed, clean exposed metal surfaces to comply with manufacturer's written instructions.
- B. Protect the installation from damage by work of other Sections. Where necessary due to heavy construction traffic, remove and properly store cover plates or seals and install temporary protection over expansion joint cover assemblies. Reinstall cover plates or seals prior to Substantial Completion.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
  - 1. Interior standard steel 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 COORDINATION

- A. Coordinate anchorage installation for hollow-metal work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.
- B. Coordinate requirements for installation of door hardware, electrified door hardware, and access control and security systems.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, core descriptions, fire-resistance ratings and finishes.
- B. Shop Drawings: Include the following:
  - 1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 2. Locations of reinforcement and preparations for hardware.
  - 3. Details of each different wall opening condition.
  - 4. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
  - 5. Details of anchorages, joints, field splices, and connections.
  - 6. Details of accessories.

7. Details of moldings, removable stops, and glazing.

C. Samples for Verification:

1. Finishes: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.

D. Product Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.

#### 1.6 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of hollow-metal door and frame assembly, for tests performed by a qualified testing agency indicating compliance with performance requirements.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

1. Provide additional protection to prevent damage to factory-finished units.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Steelcraft; an Ingersoll-Rand brand.
4. Stiles Custom Metal, Inc.
5. Republic Doors & Frames.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.



2.2 INTERIOR STANDARD STEEL FRAMES

- A. Construct hollow-metal frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.
- B. Extra-Heavy-Duty Frames: SDI A250.8, Level 3; ANSI/SDI A250.4, Level A.
  - 1. Frames:
    - a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch.
    - b. Sidelite Frames: Fabricated from same thickness material as adjacent door frame.
    - c. Construction: Face welded.
  - 2. Exposed Finish: As indicated in Door and Frame Schedule.

2.3 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
  - 2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
  - 3. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-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.
- B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:
  - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.4 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653, Commercial Steel (CS), Type B.
- E. Frame Anchors: ASTM A879/A879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A1008 or ASTM A1011, hot-dip galvanized according to ASTM A153, Class B.

- F. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A153.
- G. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.
- H. Grout: ASTM C476, except with a maximum slump of 4 inches, as measured according to ASTM C143.
- I. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.
- J. Glazing: Comply with requirements in Section 088000 "Glazing."
- K. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.5 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. Sidelite and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
  - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  - 3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  - 4. 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.
  - 5. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
      - 3) Four anchors per jamb from 90 to 120 inches high.
      - 4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

- 1) Three anchors per jamb up to 60 inches high.
  - 2) Four anchors per jamb from 60 to 90 inches high.
  - 3) Five anchors per jamb from 90 to 96 inches high.
  - 4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
- c. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
- a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
  - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- C. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.
- D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.
1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
  2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

## 2.6 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

## 2.7 ACCESSORIES

- A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.
- B. Hollow-Metal Frames: Install hollow-metal frames for doors, transoms, sidelites, and other openings, of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840.
  - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Install door silencers in frames before grouting.
    - c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - e. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation inside frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  - 5. Concrete Walls: Solidly fill space between frames and concrete with mineral-fiber insulation.
  - 6. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

- a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow-metal manufacturer's written instructions.

### 3.4 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 081113

SECTION 081416 - FLUSH WOOD DOORS

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. Solid-core doors with wood-veneer faces.
- 2. Factory finishing wood doors.
- 3. Shop priming wood doors.

B. Related Requirements:

- 1. Section 062023 "Interior Finish Carpentry" for requirements for veneers from the same flitches for both flush wood doors and wood veneer-faced architectural panels.
- 2. Section 088000 "Glazing" for glass view panels in flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including the following:

- 1. Door core materials and construction.
- 2. Door edge construction
- 3. Door face type and characteristics.
- 4. Door trim for openings.
- 5. Factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each type of door; construction details not covered in Product Data; and the following:

- 1. Door schedule indicating door location, type, size, fire protection rating, and swing.
- 2. Door elevations, dimension and locations of hardware, lite and louver cutouts, and glazing thicknesses.
- 3. Dimensions and locations of blocking.
- 4. Dimensions and locations of mortises and holes for hardware.
- 5. Undercuts.
- 6. Requirements for veneer matching.
- 7. Doors to be factory finished and application requirements.

C. Samples for Initial Selection: For factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
2. Frames for light openings, 6 inches long, for each material, type, and finish required.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Warranties.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

- A. Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
    - a. Delamination of veneer.
    - b. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - c. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers' Subject to compliance with requirements, provide products by one of the following:
  - 1. Eggers Industries
  - 2. Graham Wood Doors; ASSA-ABLOY Group company.
  - 3. Mohawk Flush Doors, Inc.
  - 4. VT Industries Inc.
  - 5. Marshfield Door Systems
  - 6. Oshkosh Door Company
  
- B. Source Limitations: Obtain wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

- A. Quality Standard: In addition to requirements specified, comply with ANSI/WDMA I.S.1-A.
  
- B. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.
  
- C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.
  - 1. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
  
- D. Particleboard-Core Doors:
  - 1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no ureaformaldehyde.
  - 2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through bolting hardware.
  - 3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.
  
- E. Structural-Composite-Lumber-Core Doors:
  - 1. Structural Composite Lumber: WDMA I.S.10.
    - a. Screw Withdrawal Face: 700 lbf.
    - b. Screw Withdrawal Edge: 400 lbf.
  
- F. Mineral-Core Doors:
  - 1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
  - 2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated as needed to eliminate through-bolting hardware.



3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges
  - a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

### 2.3 VENEER-FACED DOORS FOR OPAQUE FINISH

#### A. Interior Doors:

1. Grade: Premium, with Grade A faces.
2. Faces: Single-ply wood veneer not less than 1/50 inch thick.
  - a. Species: White Maple.
  - b. Finish: To match architect's sample.
  - c. Cut: Quarter.
  - d. Match between Veneer Leaves: Book match.
  - e. Assembly of Veneer Leaves on Door Faces: Balance match.
  - f. Pair and Set Match: Provide for doors hung in same opening.
  - g. Exposed Vertical Edges: Same species as faces – Architectural Woodwork Standards edge Type A.

### 2.4 LIGHT FRAMES AND LOUVERS

#### A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.

1. Wood Species: Same species as door face.
2. Profile: Flush rectangular beads.

### 2.5 FABRICATION

#### A. Factory fit doors to suit frame-opening sizes indicated.

1. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
2. Comply with NFPA 80 requirements for fire-rated doors.

#### B. Factory machine doors for hardware that is not surface applied.

1. Locate hardware to comply with DHI-WDHS-3.
2. Comply with final hardware schedules, door frame Shop Drawings, ANSI/BHMA-156.115-W, and hardware templates.
3. Coordinate with hardware mortises in metal frames, to verify dimensions and alignment before factory machining.
4. For doors scheduled to receive electrified locksets, provide factory-installed raceway and wiring to accommodate specified hardware.

#### C. Openings: Factory cut and trim openings through doors.

1. Light Openings: Trim openings with moldings of material and profile indicated.
2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Section 088000 "Glazing."

2.6 SHOP PRIMING

- A. Doors for Opaque Finish: Shop prime faces, all four edges, edges of cutouts, and mortises with one coat of wood primer specified in Section 099123" Interior Painting."

2.7 FACTORY FINISHING

- A. Comply with referenced quality standard for factory finishing.
  1. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  2. Finish faces, all four edges, edges of cutouts, and mortises.
  3. Stains and fillers may be omitted on bottom edges, edges of cutouts, and mortises.
- B. Factory finish doors.
- C. Transparent Finish:
  1. Architectural Woodwork Standards ANSI/WDMA I.S. 1A Grade: Premium.
  2. Finish: Architectural Woodwork Standards System-5, Varnish, Conversion.
  3. Finish: Architectural Woodwork Standards System-9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
  4. Finish: Architectural Woodwork Standards System-10, UV Curable, Water Based.
  5. Finish: Architectural Woodwork Standards System-11, Polyurethane, Catalyzed.
  6. Finish: ANSI/WDMA I.S. 1A TR-4 Conversion Varnish.
  7. Finish: ANSI/WDMA I.S. 1A TR-6 Catalyzed Polyurethane.
  8. Finish: ANSI/WDMA I.S. 1A TR-8 UV Cured Acrylated Polyester/Urethane
  9. Staining: Match Architect's sample.
  10. Effect: Filled finish.
  11. Sheen: Satin.

PART 3 - EXECUTION

3.1 EXAMINATION

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

**3.2 INSTALLATION OF SOLID-COOR DOORS WITH WOOD-VENEER FACE**

- A. Hardware: For installation, see Section 087100 "Door Hardware."
- B. Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
- C. Factory Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

**3.3 ADJUSTING**

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 081416

SECTION 084113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

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. Aluminum-framed storefront systems.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
- B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
  - 1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
  - 2. Include full-size isometric details of each type of vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
    - a. Joinery, including concealed welds.
    - b. Anchorage.
    - c. Expansion provisions.
    - d. Glazing
  - 3. Include point-to-point wiring diagrams showing the following:
    - a. Power requirements for each electrically operated door hardware.
    - b. Location and types of switches, signal device, conduit sizes, and number and size of wires.
- C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by a qualified testing agency.
- B. Qualification Statements: For Installer.
- C. Sample Warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For aluminum-framed entrances and storefronts.
- B. Maintenance Data for Structural Sealant: For structural-sealant-glazed storefront to include in maintenance manuals. Include ASTM C 1401 recommendations for post-installation-phase quality-control program.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer and that employs a qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors and that employs glazing technicians certified under the Architectural Glass and Metal Technician (AGMT) certification program.
- B. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.
  - 1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures including, but not limited to, excessive deflection.
    - b. Noise or vibration created by wind and thermal and structural movements.
    - c. Deterioration of metals and other materials beyond normal weathering.
    - d. Failure of operating components.
  - 2. Warranty Period: Five years from date of Substantial Completion.

- B. Special Finish Warranty, Factory-Applied Finishes: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Deterioration includes, but is not limited to, the following:
    - a. Color fading more than 5 Hunter units when tested according to ASTM D2244.
    - b. Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
    - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
  - 2. Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
  - 1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
  - 2. Failure also includes the following:
    - a. Thermal stresses transferring to building structure.
    - b. Glass breakage.
    - c. Noise or vibration created by wind and thermal and structural movements.
    - d. Loosening or weakening of fasteners, attachments, and other components.
    - e. Failure of operating units.

### 2.2 MANUFACTURERS

- A. Flush Glazed, Non-Thermal Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America Trifab VersaGlaze 450 Framing System 1-3/4" Sightline or a comparable product by one of the following:
  - 1. EFCO Corporation.
  - 2. Oldcastle Building Envelope.
- B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

### 2.3 STOREFRONT SYSTEMS

- A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
  - 1. Interior Vestibule Framing Construction: Nonthermal.

2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Powder-coat finish.
5. Fabrication Method: Field-fabricated stick system.
6. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
7. Steel Reinforcement: As required by manufacturer.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

#### 2.4 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door, to comply with requirements in this Section.

- a. Egress Doors: Not more than 15 lbf (67 N) to release the latch and not more than 30 lbf (133 N) to set the door in motion and not more than 15 lbf (67 N) to open the door to its minimum required width.
- b. Accessible Interior Doors: Not more than 5 lbf (22.2 N) to fully open door.

C. Designations: Requirements for design, grade, function, finish, quantity, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance 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. Manufacturers' names are abbreviated in "Entrance Door Hardware Sets" Article.

#### 2.5 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Comply with Section 088000 "Glazing."

C. Glazing Sealants: Comply with Section 088000 "Glazing."

#### 2.6 MATERIALS

A. Sheet and Plate: ASTM B209 (ASTM B209M).

B. Extruded Bars, Rods, Profiles, and Tubes: ASTM B221 (ASTM B221M).

- C. Structural Profiles: ASTM B308/B308M.
- D. Steel Reinforcement:
  - 1. Structural Shapes, Plates, and Bars: ASTM A36/A36M.
  - 2. Cold-Rolled Sheet and Strip: ASTM A1008/A1008M.
  - 3. Hot-Rolled Sheet and Strip: ASTM A1011/A1011M.
- E. Steel Reinforcement Primer: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods in accordance with recommendations in SSPC-SP COM, and prepare surfaces in accordance with applicable SSPC standard.

## 2.7 ACCESSORIES

- A. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
  - 1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
  - 2. Reinforce members as required to receive fastener threads.
  - 3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.
- B. Anchors: Three-way adjustable anchors with minimum adjustment of 1 inch that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.
- D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

## 2.8 FABRICATION

- A. Form or extrude aluminum shapes before finishing.
- B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
- C. Fabricate components that, when assembled, have the following characteristics:
  - 1. Profiles that are sharp, straight, and free of defects or deformations.
  - 2. Accurately fitted joints with ends coped or mitered.
  - 3. Physical and thermal isolation of glazing from framing members.
  - 4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
  - 5. Provisions for field replacement of glazing from interior.



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6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

1. Provide compression weather stripping at fixed stops.

F. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

## 2.9 ALUMINUM FINISHES

A. Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils (0.04 mm). Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

### 3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions.

B. Do not install damaged components.

C. Fit joints to produce hairline joints free of burrs and distortion.

D. Rigidly secure nonmovement joints.

E. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.

F. Seal perimeter and other joints watertight unless otherwise indicated.

G. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

H. Install components plumb and true in alignment with established lines and grades.

3.3 INSTALLATION OF GLAZING

- A. Install glazing as specified in Section 088000 "Glazing."

3.4 INSTALLATION OF ALUMINUM-FRAMED ENTRANCE DOORS

- A. Install entrance doors to produce smooth operation and tight fit at contact points.
1. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware in accordance with entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.5 ERECTION TOLERANCES

- A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
  2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
  3. Alignment:
    - a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
    - b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
    - c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch .
  4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Field Quality-Control Testing: Perform the following test on representative areas of aluminum-framed entrances and storefronts.
- C. Aluminum-framed entrances and storefronts will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

END OF SECTION 084113

SECTION 087100 – DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes finish hardware for the proper operation and control of all doors in the Project. Prior to bidding, notify Architect of any doors that do not have hardware meeting this intention.
- B. Hardware supplier will be responsible to furnish and install hardware on labeled doors to satisfy State and Local Building Codes.
- C. Related Sections include the following:
  - 1. Division 8 Section "Hollow Metal Doors and Frames."
  - 2. Division 8 Section "Flush Wood Doors."
  - 3. Division 8 Section "Aluminum Frames Entrances and Storefronts."

1.3 SUBMITTALS

- A. Product Data: For each product and material indicated, submit manufacturer's technical product data. Include information necessary to show compliance with requirements, installation instructions and maintenance instructions.
- B. Hardware Schedule: Submit a hardware schedule organized into sets, including the information below. Designations for door numbers and hardware sets shall match those used in the construction documents.
  - 1. Opening Number
  - 2. Door Type and Size
  - 3. Frame Type and Size
  - 4. Frame Anchoring Method
  - 5. Hardware Set
  - 6. Assembly Rating

- C. Hardware Schedule shall be coordinated with the doors, frames and related work to ensure proper size, thickness, hand function and finish of door hardware

1.4 QUALITY ASSURANCE

- A. Supplier Qualifications: A recognized Architectural Finish Hardware Supplier, with warehousing facilities, who has been furnishing hardware in the Project's vicinity for a period of not less than two (2) years. Supplier shall be or employ an experienced Architectural Hardware Consultant (AHC) who is certified by and member of the Door and Hardware Institute. The Architectural hardware Consultant shall be available, at reasonable times during the course of the work, for consultation about Project's hardware requirements, to Owner, Architect and Contractor.

- B. Fire-Rated Openings: Provide hardware for fire-rated openings in compliance with NFPA Standard No. 80, No. 101 and local building code requirements. Provide only hardware, which has been tested and listed, by UL, FM or Warnock Hersey for types and sizes of doors required and complies with requirements of door and door frame labels.
  
- C. Standards: Comply with the requirements of the latest edition of the following standards unless indicated otherwise:
  - 1. American National Standards Institute Publications:
    - a. A115 Series – Door and Frame Preparation
    - b. A156 Series – Hardware
  - 2. Builders Hardware Manufacturer's Association Publications:
    - a. 1201 – Auxiliary Hardware
    - b. 1301 – Materials and Finishes
  - 3. Door and Hardware Institute Publications:
    - a. Keying – Procedures, Systems and Nomenclature
    - b. Abbreviations and Symbols
    - c. Hardware for Labeled Fire Doors
    - d. Recommended Locations for Builder's Hardware for Standard and Custom Steel Doors and Frames
    - e. Wood Door Standards W1, W2, WDHS-2, WDHS-3
  - 4. National Fire Protection Association Publications
    - a. NFPA 80 – Standards for Fire Doors and Windows
    - b. NFPA 101 – Life Safety Code
  - 5. International Building Code – 2015 Edition
  - 6. American with Disabilities Act.

**1.5 DELIVERY, STORAGE, AND HANDLING**

- A. Package each hardware item in separate containers with all screws, wrenches, installation instructions and installation templates. Mark each box with hardware heading and door number according to approved hardware schedule.
  
- B. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation: Provide a complete packing list showing items, door numbers and hardware headings with each shipment.
  
- C. Store hardware in shipping cartons above ground and under cover to prevent damage. Provide secure lockup for door hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items that are not immediately replaceable -so that completion of the Work will not be delayed by hardware losses both before and after installation.

**1.6 PROJECT CONDITIONS**

- A. Environmental Limitations: Do not proceed with delivery and/or installation when ambient and substrate temperature conditions are outside limits permitted by material manufacturers.

**1.7 COORDINATION**

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

- B. Security: Coordinate installation of door hardware, keying, and access control with Owner's Representative.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

PART 2 – PRODUCTS

2.1 HARDWARE GENERAL

- A. Provide the materials of products indicated by trade names, manufacturer's name, or catalog number. Substitutions will not be permitted except as described in Division 1.
- B. Provide manufacturer's standard products meeting the design intent of this Specification, free of imperfections affecting appearance or serviceability.
  - 1. Provide hardware complete with all fasteners, anchors, instructions, layout templates, and any specialized tools as required for satisfactory installation and adjustment.
  - 2. Hand of Door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
  - 3. Furnish screws for installation with each hardware item. Provide Phillips flat head screws except as otherwise indicated or approved. Finish screws exposed under any condition to match hardware finish, or, if exposed in surface of other work, to match finish of such other work as closely as possible. Use machine screws for metal connections and wood screws for connections to wood. Use manufacturer's screws to secure hardware.
  - 4. Provide concealed fasteners for hardware unit with care exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt, head or nut on opposite face is exposed in other work, except where indicated otherwise or where it is not feasible to adequately reinforce the work. In such cases, provide sleeves for each thru-bolt or use sex screw fasteners.
  - 5. Special Tools: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance and removal and replacement of finish hardware.
- C. Hardware is specified in the hardware schedule by set, type and functions, which have been selected as best meeting the application requirements. Acceptable products for each category are specified in Paragraph 2.5 "Hardware Products".

2.2 SPECIAL REQUIREMENTS

- A. General:
  - 1. Where new doors and hardware are scheduled to be installed in existing frames, contractor to coordinate hinge sizes and locations, lockset backsets, strikes, hardware mounting heights, etc with existing frames to ensure new door and hardware fits and functions properly in existing frame.
- B. Hinges:
  - 1. Use heavy weight hinges for all doors.

2. Provide non-removable pins for all exterior doors and out-swinging corridor doors. Use nonrising pins for all other doors.
3. Pre-drill pilot holes for hinge fasteners at factory to suit hinge type.

C. Locksets:

1. All locksets shall accept Best 7-pin SFIC cores. Other type locksets (electric, card access, combination, and panic devices) must have a key override function
2. All areas will be served by lever-handle grade 1 cylindrical locksets, similar in construction and design quality to Best 93k series-14D lever.

D. Exit Devices:

1. All latchbolts to be deadlatching type.
2. All touchbars to be stainless steel.
3. Devices are to incorporate a flush and tapered end cap.
4. Devices incorporating plastic dogging components will not be allowed.
5. Provide electrical options as specified.

E. Closers:

1. Comply with manufacturer's recommendations for unit size based on door size and usage.
2. Provide parallel arms for all overhead closers, except as otherwise indicated.
3. All closers UL Listed Certified to be in compliance with UBC 7.2 and UL 10C.
4. Closers with Pressure Relief Valves will not be acceptable.
5. Provide any brackets or plates required for proper installation of door closers.

F. Stops

1. Provide heavy duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide overhead stop for interior doors that swing more than opens against equipment, casework, sidelights, and where conditions do not allow wall stop.

G. Thresholds and Gasketing

1. Provide thresholds, weatherstripping (including door sweeps, seals, astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
3. Gasketing and astragals on aluminum frames by door manufacturer.

## 2.3 KEYING

- A. All rim and mortise cylinders shall accept the Best 7-pin SFIC Core.
- B. All permanent Best cores and keying are provided by the Owner.
- C. The contractor is responsible to provide temporary construction cores as needed for security until the Owner installs final cores.

D. Rim and mortice cylinders shall match the same manufacturer of the lock whenever possible.

2.4 FINISHES

A. Standard: Comply with BHMA A156.18

1. All door hardware to be US26D throughout project.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer’s standards, but in no case less than specified by referenced standards for the application units of hardware.

C. Protect finishes on exposed surfaces from any damage by applying a strippable temporary protective covering before shipping.

D. BHMA Designations: Comply with base material and finish requirements indicated by BHMA standards.

2.5 HARDWARE PRODUCTS

ITEM	SPECIFIED	APPROVED EQUAL
Hinges	Ives	Stanley, McKinney, Hager, Bommer
Locksets	Best 93K Series	Schlage ND Series, Sargent 10 Line, Corbin Russwin CL3300 Series, Yale 5400LN Series
Cylinders Closers	Owner Provided LCN 4040XP Series	Sargent 281 (351) Series, Stanley D-4550 Series, Norton 9500 Series, Corbin Russwin DC8200 Series
Panic Devices	Von Duprin 99 Series	Sargent 80 Series, Precision APEX 2000 Series, Corbin Russwin ED5000 Series, Yale 7000 Series
Flatgoods	Ives	Rockwood, McKinney, Trimco, Hager
Stops	Ives	Rockwood, McKinney, Trimco, Hager
Overhead Stops Gasket	Glynn Johnson Zero	Rixson, Rockwood, Sargent NGP, Reese

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and frames with installer present for compliance with the requirements, for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

- B. Examine rough-in for electrical source power to verify actual locations of wiring connections before electrified door hardware installation.
- C. Notify Architect of any discrepancies or conflicts between the door schedule, door types, frame types, drawings, scheduled hardware and built condition.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Steel Frames: Comply with ANSI/DHI A115 Series
- B. Wood Doors: Comply with ANSI/DHI A115-W Series.

**3.3 INSTALLATION**

- A. Mounting Heights: Mount door hardware units at heights indicated in the following applicable publications, or as 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."
  - 2. Custom Steel Doors and Frames: DHI's "Recommended Locations for Builder's Hardware for Custom Steel Doors and Frames."
  - 3. Wood Doors: DHI WDHS.2 "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to complete 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 to with finishing work. Do not install surface mounted items until finishes have been completed on substrates involved.

**3.4 FIELD QUALITY CONTROL**

- A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in written report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

**3.5 ADJUSTING**

- A. Initial Adjustment: Adjust and check each operating items of door hardware and each door to ensure proper operation of function of every unit. Replace units that cannot be adjusted to operate as intended and/or required. Adjust door control devices to compensation for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

**3.6 CLEANING AND PROTECTION**

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper finish, and provide final protection and maintain condition that ensure door hardware is without damage or deterioration at time of owner occupancy.



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## 3.7 DEMONSTRATION AND TRAINING

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain door hardware and door hardware finishes.







## 3.8 DOOR HARDWARE SETS

### Hardware Group No. 1

For use on Door #(s):

125Q                      125U

Provide each SGL door(s) with the following:





QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	SFIC	OWNER PROVIDED		626	BES
1	EA	CLASSROOM LOCK	9K7R 14D		626	BES
1	EA	OH STOP	90S J @ 125U		630	GLY
1	EA	WALL STOP	WS406/407CCV @ 125Q		626	IVE
1	EA	SILENCER	SR64/SR65 AS REQ'D		GRY	IVE

### Hardware Group No. 2

For use on Door #(s):

125C                      125D                      125E                      125F                      125G                      125H  
125J                      125K                      125O                      125P                      125S                      125T

Provide each SGL door(s) with the following:






QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	SFIC	OWNER PROVIDED		626	BES
1	EA	ENTRANCE LOCK	9K7AB 14D		626	BES
1	EA	WALL STOP	WS406/407CCV		626	IVE

### Hardware Group No. 3

For use on Door #(s):

125L

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	93K0N 14D		626	BES
1	EA	SURFACE CLOSER	4040XP CUSH		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D		GRY	IVE

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Hardware Group No. 4

For use on Door #(s):

125Z

Provide each SGL door(s) with the following:







QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	PASSAGE SET	93K0N 14D		626	BES
1	EA	SURFACE CLOSER	4040XP REG OR PA AS REQ		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407CCV		626	IVE
3	EA	SILENCER	SR64/SR65 AS REQ'D		GRY	IVE

Hardware Group No. 5

For use on Door #(s):

125

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
6	EA	HINGE	5BB1HW 4.5 X 4.5		652	IVE
1	EA	SFIC	OWNER PROVIDED		626	BES
1	EA	PANIC HARDWARE	9947-L-DT-LBR-17		626	VON
1	EA	PANIC HARDWARE	9947-L-LBR-17		626	VON
1	EA	SFIC RIM HOUSING	12E72 (VERIFY TYPE REQ'D)		626	BES
2	EA	SURFACE CLOSER	4040XP CUSH		689	LCN
2	EA	SILENCER	SR64/SR65 AS REQ'D		GRY	IVE

Hardware Group No. 6

For use on Door #(s):

125R            125V            125W            125X            139J            A101-B  
A101            AC100A            AC100B            AS100C            AV100B

Provide each SGL door(s) with the following:


QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
		DOOR IS EXISTING AND HARDWARE TO REMAIN.				

Hardware Group No. 7

For use on Door #(s):

C100C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	EA	MAGNET	SEM7850 12V/24V/120V		689	LCN
REMAINDER OF HARDWARE IS EXISTING AND TO REMAIN.						

END OF SECTION 087100

SECTION 088000 - GLAZING

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. Glass products.
  - 2. Glazing sealants.
  - 3. Specialty Window Films

1.3 DEFINITIONS

- A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C1036.
- C. IBC: International Building Code.

1.4 COORDINATION

- A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples: For Specialty Window Films selected from Manufacturer's standard range.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For fabricated glass and glazing sealants, for tests performed by a qualified testing agency.

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1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

## 1.7 QUALITY ASSURANCE

- A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer
- B. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
- C. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
  1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

## 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
  1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Guardian Industries Corp.
  2. ACH Float Glass Operations.
  3. AGC Glass Company – North America.
  4. Viracon, Inc.
  5. Vitro (formally PPG).
- B. Source Limitations for Glass: Obtain glass from single source from single manufacturer.

- C. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

## 2.2 PERFORMANCE REQUIREMENTS

- A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.
- C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:
  - 1. For monolithic-glass lites, properties are based on units with lites 1/4" (6 mm) thick.
- D. Acoustic Performance:
  - 1. Interior Glazing: 41 STC.

## 2.3 GLASS PRODUCTS, GENERAL

- A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.
  - 1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."
- B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or manufacturer. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.
- C. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
  - 1. Minimum Glass Thickness for Interior Lites: 1/4" (6 mm).
- D. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

- A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear), Quality-Q3.

2.5 GLAZING SEALANTS

- A. General:
  - 1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
  - 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
  - 3. Field-applied sealants shall have a VOC content of not more than 250 g/L.
  - 4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 100/50, Use NT.
- C. Products: Subject to compliance with requirements, provide one of the following:
  - 1. Tremco Proglaze
  - 2. General Electric
  - 3. DAP
  - 4. Pecora

2.6 SPECIALTY WINDOW FILMS

- A. Custom Cut Decorative Glass Film:
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide LLumar Films, or approved equal by architect.
  - 2. Product: To be selected from Manufacturer's standard range.
  - 3. Locations: As indicated on Window Elevations. To be installed on interior side of glass.

2.7 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

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- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Glazing Tape: Butyl or silicone preshimmed tape similar to Tremco 440 Tape.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:
  - 1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
  - 2. Presence and functioning of weep systems.
  - 3. Minimum required face and edge clearances.
  - 4. Effective sealing between joints of glass-framing members.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.
- B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

### 3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge

damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

- C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.
- D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- F. Provide spacers for glass lites where length plus width is larger than 50 inches.
  - 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
  - 2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

### 3.4 GASKET GLAZING (DRY)

- A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.
- B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.
- C. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.
- D. Install gaskets so they protrude past face of glazing stops.

### 3.5 CLEANING AND PROTECTION

- A. Immediately after installation remove nonpermanent labels and clean surfaces.



- B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.
  - 1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.
- C. Remove and replace glass that is damaged during construction period.
- D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.6 MONOLITHIC GLASS SCHEDULE

- A. Clear Glass Type <GLZ-1>: Fully tempered float glass.
  - 1. Minimum Thickness: ¼" (6 mm).
- B. Clear Glass Type <GLZ-2>: Fully tempered float glass with specialty window film.
  - 1. Minimum Thickness: ¼" (6 mm).

END OF SECTION 088000

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior partitions.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For embossed, high-strength steel studs and tracks and firestop tracks, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Notify manufacturer of damaged materials received prior to installation.
- B. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- C. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling as required by AISI S202, "Code of Standard Practice for Cold-Formed Steel Structural Framing."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- 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 E119 by an independent testing agency.

- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Design framing systems in accordance with AISI S220, "North American Specification for the Design of Cold-Formed Steel Framing - Nonstructural Members," unless otherwise indicated.
- D. Design Loads: As indicated on architectural Drawings or 5 lbf/sq. ft. minimum as required by the IBC.

2.2 FRAMING SYSTEMS

- A. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. ClarkDietrich.
    - b. MarinoWARE.
    - c. SCAFCO Steel Stud Company.
    - d. Minimum Base-Steel Thickness: 0.0190 inch.
    - e. Depth: As indicated on Drawings.
  - B. Slip-Type Head Joints: Where indicated, provide the following:
    - 1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
        - 1) ClarkDietrich.
        - 2) MarinoWARE.
        - 3) SCAFCO Steel Stud Company.
  - C. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. ClarkDietrich.
      - b. MarinoWARE.
      - c. SCAFCO Steel Stud Company
  - D. Hat-Shaped, Rigid Furring Channels: ASTM C645.
    - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. ClarkDietrich.
      - b. MarinoWARE.
      - c. SCAFCO Steel Stud Company

2. Minimum Base-Steel Thickness: 0.0296 inch.
3. Depth: 7/8 inch.

### 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide the following:
  1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## PART 3 - EXECUTION

### 3.1 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 of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
  1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
  1. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. 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.
- E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 092216

SECTION 092613 – GYPSUM VENEER PLASTERING

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. Gypsum veneer plaster and gypsum base for interior veneer plaster.
  - 2. Gypsum veneer plaster over interior masonry surfaces.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

- A. Mockups: Provide a full-thickness finish mockup for each type and finish of gypsum veneer plaster and substrate to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select representative surfaces and conditions for application of each type of gypsum veneer plaster and substrate.
  - 2. Provide mockups of partitions in sizes of at least 16 sq. ft.
  - 3. Apply gypsum veneer plaster, according to requirements for the completed Work, after permanent lighting and other environmental services have been activated.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, and bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover, and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes.
- C. Stack panels flat on leveled supports off floor or slab to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C843 requirements or gypsum veneer plaster manufacturer's written recommendations, whichever are more stringent.
- B. Room Temperatures: Maintain not less than 55 deg F or more than 80 deg F for seven days before application of gypsum base and gypsum veneer plaster, continuously during application, and after application until veneer plaster is dry.
- C. Avoid conditions that result in gypsum veneer plaster drying too rapidly.
  - 1. Distribute heat evenly; prevent concentrated or uneven heat on veneer plaster.
  - 2. Maintain relative humidity levels, for prevailing ambient temperature, that produce normal drying conditions.
  - 3. Ventilate building spaces in a manner that prevents drafts of air from contacting surfaces during veneer plaster application until it is dry.
- D. Do not install panels that are wet, moisture damaged, mold damaged, or faded from overexposure to sunlight.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain gypsum veneer plaster products, including gypsum base for veneer plaster, joint reinforcing tape, and embedding material, from single manufacturer.

2.2 GYPSUM VENEER PLASTER

- A. Two-Component Gypsum Veneer Plaster: ASTM C587, with separate formulations; one for base-coat application and one for finish-coat application over substrates.
  - 1. Base Coat:
    - a. Basis-of-Design: Gold Bond – Two-way Hardwall Plaster
  - 2. Finish Coat:
    - a. Basis-of-Design: Gold Bond – X-KALibur Veneer Plaster

2.3 TRIM ACCESSORIES

- A. Standard Trim: ASTM C1047, provided or approved by manufacturer for use in gypsum veneer plaster applications indicated.
  - 1. Material: Paper-faced, galvanized-steel sheet.
  - 2. Shapes:
    - a. U-Bead: J-shaped; exposed short flange does not receive veneer plaster.
    - b. Control joints.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced product standards and manufacturer's written recommendations.
- B. Bonding Agent: ASTM C631 polyvinyl acetate.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.
- C. Masonry Substrates: Verify that mortar joints are struck flush.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Masonry Substrates: Prepare according to gypsum veneer plaster manufacturer's written recommendations and as follows:
  - 1. Clean surfaces to remove dirt, grease, oil, and other foreign matter and deposits that could impair bond with gypsum veneer plaster.
  - 2. Apply bonding agent on dry masonry substrates.

3.3 INSTALLING TRIM ACCESSORIES

- A. General: Install trim with back flanges intended for fasteners, and attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.



B. Control Joints: Install at locations indicated on Drawings.

C. Trim: Install in the following locations:

1. U-Bead: Use where indicated.

### 3.4 GYPSUM VENEER PLASTERING

A. Bonding Agent: Apply bonding agent on dry masonry according to gypsum veneer plaster manufacturer's written recommendations.

B. Gypsum Veneer Plaster Mixing: Mechanically mix gypsum veneer plaster materials to comply with ASTM C843 and with gypsum veneer plaster manufacturer's written recommendations.

C. Gypsum Veneer Plaster Application: Comply with ASTM C843 and with veneer plaster manufacturer's written recommendations.

1. Two-Component Gypsum Veneer Plaster:

a. Base Coat: Hand trowel or machine apply base coat over substrate to a uniform thickness of 3/32 inch, Fill voids and imperfections.

b. Finish Coat: Trowel apply finish-coat plaster over base-coat plaster to a uniform thickness of 3/32 inch.

2. Where gypsum veneer plaster abuts metal, including doorframes, windows and other units, groove finish coat to eliminate spalling.

D. Concealed Surfaces: Do not omit gypsum veneer plaster behind cabinets, furniture, furnishings, and similar removable items. Omit veneer plaster in the following areas where it will be concealed from view in the completed Work unless otherwise indicated or required to maintain fire-resistance and STC ratings:

1. Above suspended ceilings.

E. Gypsum Veneer Plaster Finish: Smooth-troweled finish unless otherwise indicated.

### 3.5 PROTECTION

A. Protect installed gypsum veneer plaster from damage from weather, condensation, construction, and other causes during remainder of the construction period.

B. Remove and replace gypsum veneer plaster and gypsum base panels that are wet, moisture damaged, or mold damaged.

1. Indications that gypsum base panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.

2. Indications that gypsum base panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092613

SECTION 092900 - 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. Section Includes:

- 1. Interior gypsum board.
- 2. Suspension systems for interior ceilings and soffits.
- 3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

- 1. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
- 2. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.

1.3 ACTION SUBMITTALS

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

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.

- B. Do not install panels that are wet, moisture damaged, and mold damaged.

- 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
- 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 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.

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Board, Type X: ASTM C 1396/C 1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Building Products.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.
- B. Gypsum Ceiling Board, Type X: ASTM C1396/C1396M.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Georgia-Pacific Building Products.
    - b. National Gypsum Company.
    - c. USG Corporation.
  - 2. Thickness: 5/8 inch.
  - 3. Long Edges: Tapered.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
  - 1. Material: Paper-faced galvanized-steel sheet.

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

## 2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use drying-type, all-purpose compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
  5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

## 2.5 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.
- B. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Ceiling & Wall Solutions.
    - b. Certainteed; SAINT-GOBAIN.
    - c. USG Corporation.

2.6 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- 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.
- C. Sound-Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
  - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.
- D. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 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. Grabber Construction Products; Acoustical Sealant GSC.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.
  - 2. Sealant shall have a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- 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. 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. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 INSTALLATION OF INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  - 1. Wallboard Type: As indicated on Drawings.
  - 2. Type X: Vertical and ceiling surfaces unless otherwise indicated.
- B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
2. On partitions/walls, apply gypsum panels horizontally (perpendicular 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.
  - b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:

1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
3. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  1. Hangers: 48 inches o.c.
  2. Carrying Channels (Main Runners): 48 inches o.c.
  3. Furring Channels (Furring Members): 16 inches o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
    - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
- 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
- 4. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

### 3.5 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 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.
  - 2. LC-Bead: Use at exposed panel edges.
  - 3. L-Bead: Use where indicated.

### 3.6 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 for trim products specifically indicated as not intended to receive 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 4: At panel surfaces that will be exposed to view unless otherwise indicated
    - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."



3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. 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 092900

SECTION 095113 - ACOUSTICAL PANEL CEILINGS

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 acoustical panels and exposed suspension systems for interior ceilings.

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, 6 inches in size.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Method of attaching hangers to building structure.
  - 3. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
  - 4. Items penetrating finished ceiling and ceiling-mounted items including the following:
    - a. Lighting fixtures.
    - b. Diffusers.
    - c. Grilles.
    - d. Fire Alarm Devices.
    - e. AV Equipment.
    - f. Access panels.
    - g. Perimeter moldings.
  - 5. Minimum Drawing Scale: 1/4 inch = 1 foot.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

- D. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.

1.5 CLOSEOUT SUBMITTALS

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

1.6 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. Acoustical Ceiling Units: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
  - 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

**PART 2 - PRODUCTS**

2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of acoustical ceiling panel and its supporting suspension system from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- 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: Class A according to ASTM E 1264.
  - 2. Smoke-Developed Index: 50 or less.

2.3 ACOUSTICAL PANELS <ACT-1>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; Optima or a comparable product by one of the following:
  - 1. CertainTeed Corporation.
  - 2. Chicago Metallic Corporation.
  - 3. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
  - 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
  - 2. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.90.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.
- G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
- H. Thickness: 9/16 inch.
- I. Modular Size: 24 by 24 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

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## 2.4 ACOUSTICAL PANELS <ACT-2>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; Optima or a comparable product by one of the following:
  - 1. CertainTeed Corporation.
  - 2. Chicago Metallic Corporation.
  - 3. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:
  - 1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
  - 2. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.90.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.
- G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
- H. Thickness: 9/16 inch.
- I. Modular Size: 24 by 48 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.5 ACOUSTICAL PANELS <ACT-3>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; Optima or a comparable product by one of the following:
  - 1. CertainTeed Corporation.
  - 2. Chicago Metallic Corporation.
  - 3. USG Corporation.
- B. Acoustical Panel Standard: Provide manufacturer's standard panels according to ASTM E 1264 and designated by type, form, pattern, acoustical rating, and light reflectance unless otherwise indicated.
- C. Classification: Provide panels as follows:

1. Type and Form: Type XII, glass-fiber base with membrane-faced overlay; Form 2, cloth. Binder shall not contain urea formaldehyde.
  2. Pattern: E (lightly textured).
- D. Color: White.
- E. Light Reflectance (LR): Not less than 0.90.
- F. Noise Reduction Coefficient (NRC): Not less than 0.95.
- G. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.
- H. Thickness: 9/16 inch.
- I. Modular Size: 24 by 72 inches.
- J. Antimicrobial Treatment: Manufacturer's standard broad spectrum, antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273, ASTM D 3274, or ASTM G 21 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.6 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armstrong World Industries, Inc.
  2. CertainTeed Corporation.
  3. Chicago Metallic Corporation.
  4. USG Corporation.
- B. Metal Suspension-System Standard: Provide manufacturer's standard, direct-hung, metal suspension system and accessories according to ASTM C 635/C 635M and designated by type, structural classification, and finish indicated.
- C. Narrow-Face, Uncapped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; to produce structural members with 9/16-inch-wide faces.
1. Structural Classification: Heavy-duty system.
  2. Face Design: With 1/8-inch-wide, slotted, box-shaped flange.
  3. Face Finish: Painted white.
  4. Reveal Finish: Painted to match flange color.

## 2.7 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488/E 488M or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: Postinstalled expansion anchors.
- b. Corrosion Protection: Carbon-steel components zinc plated according to ASTM B 633, Class SC 1 (mild) service condition.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

- B. Wire Hangers, Braces, and Ties: Provide wires as follows:

1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- diameter wire.

## 2.8 METAL EDGE MOLDINGS AND TRIM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Armstrong World Industries, Inc; Axiom or a comparable product by one of the following:

1. CertainTeed Corporation.
2. Chicago Metallic Corporation.
3. USG Corporation.

- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Edge moldings shall fit acoustical panel edge details and suspension systems indicated and match width and configuration of exposed runners unless otherwise indicated.
2. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

- C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements.

1. Powder-Coat Finish: Minimum dry film thickness of 1.5 mils. Comply with ASTM C635/C635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.9 ACOUSTICAL SEALANT

- A. Acoustical Sealant: As specified in Section 092900 "Gypsum Board."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

3.3 INSTALLATION

- A. Install acoustical panel ceilings according to ASTM C 636/C 636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.



4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  6. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  7. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
  2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.
- B. Moldings and Trim: Install moldings and trim to substrate and level with ceiling suspension system to a tolerance of 1/8 inch in 12 feet, non-cumulative.

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### 3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 095113

SECTION 096513 – WALL BASE AND ACCESSORIES

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. Thermoset-rubber base.
  - 2. Aluminum reveal base.
  - 3. Aluminum accessories.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

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. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive products during the following periods:
  - 1. 48 hours before installation.

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2. During installation.
  3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install products after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 THERMOSET-RUBBER BASE <RB-1>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Johnsonite; A Tarkett Company: Baseworks Rubber Wall Base or comparable product by one of the following:
1. Flexco Floors.
  2. Roppe Corporation, USA.
- B. Product Standard: ASTM F 1861, Type TS (rubber, vulcanized thermoset), Group I (solid, homogeneous).
1. Style and Location:
    - a. Style A, Straight
- C. Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Job formed.
- G. Inside Corners: Job formed.
- H. Colors: Charcoal #20

### 2.2 ALUMINUM REVEAL BASE <MB-1>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet, Reveal Base and Millwork Reveal Base or comparable product by one of the following:
1. Gordon, Inc.
  2. Pittcon Industries.
- B. Product Standard: ASTM B 221, Alloy 6063-T5.
1. Style and Location:

- a. Style A, Drywall Reveal Base: Provide in areas indicated.
- b. Style B, Millwork Reveal Base: Provide in areas indicated.
  
- C. Height: 4 inches.
  
- D. Lengths: In maximum available lengths to minimize running joints.
  
- E. Outside Corners: Job formed.
  
- F. Inside Corners: Job formed.
  
- G. Colors: Powder Coat Black

2.3 ALUMINUM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
  - 1. Futura Transitions by Bonnell Aluminum.
  - 2. Tarkett.
  - 3. Shaw Contract.
  
- B. Description: Aluminum transition strips.
  
- C. Profile and Dimensions: Refer to Construction Drawings for types of transitions. Coordinate with various material thicknesses, and field verify transitions to existing flooring.
  
- D. Locations: Provide flooring transitions at all transitions between different flooring types.
  
- E. Lengths: In maximum available lengths to minimize running joints.
  
- F. Colors: To be selected from Manufacturer's standard colors.

2.4 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.
  
- B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.
  
- C. Metal Edge Strips: Extruded aluminum with mill finish nominal 2 inches (50.8 mm) wide, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
  - 1. Installation of products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

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

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 indicated.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

- G. Job-Formed Corners:
  - 1. Outside Corners: Use preformed corners.
  - 2. Inside Corners: Use preformed corners.

**3.4 ALUMINUM BASE INSTALLATION**

- A. Comply with manufacturer's written instructions for installing aluminum base.
- B. Apply aluminum base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where indicated.
- C. Install aluminum base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere aluminum base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

**3.5 ALUMINUM ACCESSORY INSTALLATION**

- A. Comply with manufacturer's written instructions for installing aluminum accessories.
- B. Aluminum 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 protecting resilient and aluminum products.
- B. Perform the following operations immediately after completing product installation:
  - 1. Remove adhesive and other blemishes from surfaces.
- C. Protect products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 096519 - RESILIENT TILE FLOORING

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. Solid vinyl floor tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For each type of resilient floor tile.
  - 1. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
  - 2. Show details of special patterns.
- C. Samples for Verification: Full-size units of each color and pattern of floor tile required.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.6 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.



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## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by floor tile manufacturer for installation techniques required.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

## 1.9 FIELD CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For resilient floor tile, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 SOLID VINYL FLOOR TILE <LVT-1>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Bentley Mills; Balustrade Series, or approved equal by architect.

- B. Tile Standard: ASTM F 1700.
  - 1. Class: Class III, printed film vinyl tile.
  - 2. Type: B, solid vinyl floor.
- C. Thickness: 5 mm backing and 20 mil wear layer.
- D. Size: 18 by 36 inches.
- E. Colors and Patterns: Beaux Arts 802116.

**2.3 SOLID VINYL FLOOR TILE <LVT-2>**

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Mannington Commercial; Color Anchor Groove Series, or approved equal by architect.
- B. Tile Standard: ASTM F 1700.
  - 1. Class: Class III, printed film vinyl tile.
  - 2. Type: B, solid vinyl floor.
- C. Thickness: 2.5 mm backing and 20 mil wear layer.
- D. Size: 18 by 18 inches.
- E. Colors and Patterns: Misty Mountain C161.

**2.4 INSTALLATION MATERIALS**

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F710.
  - 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 floor tile manufacturer. Do not use solvents.
  - 3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 7 pH.
  - 4. Moisture Testing: Proceed with installation only after substrates pass testing according to floor tile manufacturer's written recommendations, but not less stringent than the following:
    - a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 6 lb of water/1000 sq. ft. in 24 hours.
    - b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 80 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 floor tiles until materials are the same temperature as space where they are to be installed.
  - 1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.
- E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.3 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 with grain running in one direction in Ashlar/Staggered pattern.
  - 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 unless otherwise indicated on Construction Drawings.
  - 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. Adhere floor tiles to 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.
- 3.4 CLEANING AND PROTECTION
- A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.
  - B. Perform the following operations immediately after completing floor tile installation:
    1. Remove adhesive and other blemishes from surfaces.
    2. Sweep and vacuum surfaces thoroughly.
    3. Damp-mop surfaces to remove marks and soil.
  - C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
  - D. Cover floor tile until Substantial Completion.

END OF SECTION 096519

SECTION 096813 - TILE CARPETING

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 modular carpet tile.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
  - 2. Include manufacturer's written installation recommendations for each type of substrate.
- B. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
  - 1. Carpet Tile: Full-size Sample.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
  - 1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  - 2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd..

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI's "CRI Carpet Installation Standard."

1.9 FIELD CONDITIONS

- A. Comply with CRI's "CRI Carpet Installation Standard" for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at levels planned for building occupants during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, the following:
    - a. More than 10 percent edge raveling, snags, and runs.
    - b. Dimensional instability.
    - c. Excess static discharge.
    - d. Loss of tuft-bind strength.

- e. Loss of face fiber.
  - f. Delamination.
3. Warranty Period: Lifetime.

PART 2 - PRODUCTS

2.1 CARPET TILE <CPT-1>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett; Grid Overlay II tile or a comparable product as approved by the Architect.
- B. Color: Clean Coal 44030.
- C. Installation Method: Ashlar.
- D. Dye Method: 100% solution dyed.
- E. Fiber Content: 100 percent nylon.
- F. Pile Thickness: 0.075 inches for finished carpet tile.
- G. Surface Pile Weight: 18 oz./sq. yd.
- H. Backing System: Ethos Modular with Omnicoat.
- I. Size: 24 by 24 inches.
- J. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.2 CARPET TILE <CPT-2>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett; Grid Overlay II tile or a comparable product as approved by the Architect.
- B. Color: Total Eclipse 44022.
- C. Installation Method: Ashlar.
- D. Dye Method: 100% solution dyed.

- E. Fiber Content: 100 percent nylon.
- F. Pile Thickness: 0.075 inches for finished carpet tile.
- G. Surface Pile Weight: 18 oz./sq. yd.
- H. Backing System: Ethos Modular with Omnicoat.
- I. Size: 24 by 24 inches.
- J. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.

2.3 CARPET TILE <CPT-3>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Tarkett; Abrasive Action II tile or a comparable product as approved by the Architect.
- B. Color: Charcoal 19100.
- C. Installation Method: Monolithic with welded seams.
- D. Dye Method: 100% solution dyed.
- E. Fiber Content: 100 percent nylon.
- F. Pile Thickness: 0.115 inches for finished carpet tile.
- G. Surface Pile Weight: 24 oz./sq. yd.
- H. Backing System: Ethos Modular with Omnicoat.
- I. Size: 24 by 24 inches.
- J. Applied Treatments:
  - 1. Soil-Resistance Treatment: Manufacturer's standard treatment.
  - 2. Antimicrobial Treatment: Manufacturer's standard treatment that protects carpet tiles as follows:
    - a. Antimicrobial Activity: Not less than 2-mm halo of inhibition for gram-positive bacteria, not less than 1-mm halo of inhibition for gram-negative bacteria, and no fungal growth, according to AATCC 174.



2.4 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance.
- B. Examine carpet tile for type, color, pattern, and potential defects.
- C. Concrete Slabs: Verify that finishes comply with requirements specified in Section 033000 "Cast-in-Place Concrete" and that surfaces are free of cracks, ridges, depressions, scale, and foreign deposits.
  - 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 F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    - b. Relative Humidity Test: Using in situ probes, ASTM F2170. 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 tile manufacturers. Proceed with installation only after substrates pass testing.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. General: Comply with CRI's "Carpet Installation Standards" and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.
- 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 tile manufacturers.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI's "CRI Carpet Installation Standard," Section 18, "Modular Carpet" and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.
- C. Maintain dye-lot integrity. Do not mix dye lots in same area.
- D. Maintain pile-direction patterns recommended in writing by carpet tile manufacturer.
- E. Cut and fit carpet tile 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 tile manufacturer.
- F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.
- H. Install pattern parallel to walls and borders.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI's "Carpet Installation Standard," Section 20, "Protecting Indoor Installations."

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- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 097200 - WALL COVERINGS

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. Vinyl wall covering.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement seams and termination points.
- C. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.
- D. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at

levels intended for occupants after Project completion during the remainder of the construction period.

- B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates in accordance with test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 50 or less.

### 2.2 VINYL WALL COVERING <VWG-1>

- A. Description: Provide vinyl products in rolls from same production run and complying with the following:
  - 1. FS CCC-W-408D for Type II, Medium Duty.
- B. Total Weight: 2 oz. / yd., excluding coatings.
- C. Width: 54 inches.
- D. Backing: Osnaburg fabric.
  - 1. Fiber Content: Polycotton.
- E. Mildew Resistance: Rating of zero or 1 when tested in accordance with ASTM G21.
- F. Colors, Textures, and Patterns: Custom graphics as provided by Architect.

### 2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

- B. Seam Tape: As recommended in writing by wall-covering manufacturer.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.
- C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
  - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
  - 2. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
- D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

**3.3 INSTALLATION OF WALL COVERING**

- A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
- B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
- D. Install wall covering without lifted or curling edges and without visible shrinkage.
- E. Match pattern throughout installation.

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- F. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
- H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

### 3.4 CLEANING

- A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 099123 - INTERIOR PAINTING

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. Primers.
  - 2. Water-based finish coatings.
  - 3. Stains and transparent finishes.

1.3 DEFINITIONS

- A. MPI Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- C. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- D. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- E. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
  - 1. Include preparation requirements and application instructions.
  - 2. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
  - 3. Indicate VOC content.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
  - 1. Submit Samples on rigid backing, 8 inches square.
  - 2. Apply coats on Samples in steps to show each coat required for system.
  - 3. Label each coat of each Sample.



4. Label each Sample for location and application area.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Paint Products: 5 percent, but not less than 1 gal. of each material and color applied.
  2. Stains and Transparent Finishes: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 QUALITY ASSURANCE

- A. Stains and Transparent Finishes Mockups: Apply mockups of each finish system indicated and each color selected to verify preliminary selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  1. Architect will select one surface to represent surfaces and conditions for application of each type of finish system and substrate.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 10 sq. ft..
    - b. Other Items: Architect will designate items or areas required.
  2. Final approval of stain color selections will be based on mockups.
    - a. If preliminary stain color selections are not approved, apply additional mockups of additional stain colors selected by Architect at no added cost to Owner.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.
  1. Maintain containers in clean condition, free of foreign materials and residue.
  2. Remove rags and waste from storage areas daily.

1.8 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures of less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, undefined:
  - 1. Benjamin Moore & Co.
  - 2. PPG Paints.
  - 3. Sherwin-Williams Company (The).
  
- A. Source Limitations: Obtain each paint product from single source from single manufacturer. Products: Subject to compliance with requirements, provide one of the products listed in wood finish systems schedules for the product category indicated.

2.2 PAINT PRODUCTS, GENERAL

- A. Material Compatibility:
  - 1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.
  
- B. Colors: As indicated in a color schedule.

2.3 PRIMERS

- A. Interior Latex Primer Sealer: Water-based latex sealer used on new interior plaster and gypsum wallboard surfaces.
  - 1. PPG: Speedhide Int. Latex Primer Sealer.
  - 2. Akzo Nobel Paints: Glidden Pro. Hi-Hide Wall Interior Water-Based Primer Sealer.
  - 3. Benjamin Moore: Super Spec Latex Enamel Undercoater & Primer Sealer.
  - 4. Sherwin-Williams: ProMar 200 Int. Latex Primer Primer.
  
- B. METAL PRIMERS
  - 1. Primer, Rust-Inhibitive, Water Based: MPI #107.
    - a. PPG: Pitt-Tech Int/Ext DTM Industrial Primer Gray.
    - b. Akzo Nobel Paints: Devoe DEVFLEX 4020 Direct to Metal Primer & Flat Finish.
    - c. Benjamin Moore: IRONCLAD Latex Low Lustre Metal & Wood Enamel.
    - d. Sherwin-Williams: Pro -Cryl Universal Primer.

2.4 WATER-BASED FINISH COATS

- A. Latex, Interior, Flat, (Gloss Level 1): MPI #53.

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1. PPG: Speedhide Interior Flat Latex.
  2. Akzo Nobel Paints: Glidden Pro. Diamond 450 Interior Premium Acrylic Eggshell.
  3. Benjamin Moore: Super Spec Premium Latex Interior Flat Finish.
  4. Sherwin-Williams: ProMar 200 Interior Latex Flat.
- B. Latex, Interior, Eggshell, (Gloss Level 2): MPI #44.
1. PPG: Speedhide Interior Eggshell Latex.
  2. Akzo Nobel Paints: Glidden Pro. Diamond 450 Interior Premium Acrylic Flat.
  3. Benjamin Moore: Super Spec Premium Latex Interior Eggshell Enamel.
  4. Sherwin-Williams: ProMar 200 Interior Latex Eg-Shel.
- C. Light Industrial Coating, Interior, Water Based, Semi-Gloss (Gloss Level 5): MPI #153.
1. PPG: Pitt-Tech Int/Ext High Semi-Gloss DTM Industrial Enamels.
  2. Akzo Nobel Paints: Devoe DEVFLEX 4216 High Performance WB Acrylic SG Enamel.
  3. Benjamin Moore: Super Spec D.T.M. Acrylic Semi-Gloss Enamel.
  4. Sherwin-Williams: Sher-Cryl HPA Semi-Gloss.

## 2.5 STAINING AND TRANSPARENT FINISHES, GENERAL

- A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products List."
- B. Material Compatibility:
1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, products shall be recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
1. Clear Wood Finishes, Varnishes: 350 g/L.
  2. Clear Wood Finishes, Lacquers: 550 g/L.
  3. Shellacs, Clear: 730 g/L.
  4. Stains: 250 g/L.
- D. Stain Colors: As selected by Architect from manufacturer's full range.
- E. Source Quality Control:
1. Testing of Materials: Owner reserves the right to invoke the following procedure:
    - a. Owner will engage the services of a qualified testing agency to sample wood finishing materials. Contractor will be notified in advance and may be present when samples are taken. If materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

- b. Testing agency will perform tests for compliance with product requirements.
- c. Owner may direct Contractor to stop applying wood finishes if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying materials from Project site, pay for testing, and refinish surfaces finished with rejected materials. Contractor will be required to remove rejected materials from previously finished surfaces before refinishing with complying materials if the two finishes are incompatible or produce results that, in the opinion of the Architect, are aesthetically unacceptable.

### 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. Gypsum Board: 12 percent.
  - 2. Interior Wood Substrates: 10 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.
- F. 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 applicable to substrates and paint systems indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Clean and prepare surfaces to be finished according to manufacturer's written instructions for each substrate condition and as specified.
1. Remove dust, dirt, oil, and grease by washing with a detergent solution; rinse thoroughly with clean water and allow to dry. Remove grade stamps and pencil marks by sanding lightly. Remove loose wood fibers by brushing.
  2. Remove mildew by scrubbing with a commercial wash formulated for mildew removal and as recommended by stain manufacturer.
- E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- F. Interior Wood Substrates:
1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  2. Apply wood filler paste to open-grain woods, as defined in "MPI Architectural Painting Specification Manual," to produce smooth, glasslike finish.
  3. Sand surfaces exposed to view and dust off.
  4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dry.

### 3.3 INSTALLATION

- A. Apply finishes according to manufacturer's written instructions.
1. Use applicators and techniques suited for paint and substrate indicated.
  2. Finish surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, finish surfaces behind permanently fixed equipment or furniture with prime coat only.
  3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  4. Do not apply finishes over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply finishes 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. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
  - 1. Do not clean equipment with free-draining water and prevent solvents, thinners, cleaners, and other contaminants from entering into waterways, sanitary and storm drain systems, and ground.
  - 2. Dispose of contaminants in accordance with requirements of authorities having jurisdiction.
  - 3. Allow empty paint cans to dry before disposal.
- B. After completing finish application, clean spattered surfaces. Remove spattered materials by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from finish application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.5 INTERIOR FINISHING SCHEDULE

- A. Steel Substrates:
  - 1. Water-Based Light Industrial Coating System:
    - a. Prime Coat: Primer, rust-inhibitive, water based MPI #107.
    - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
    - c. Topcoat: Light industrial coating, interior, water based, semi-gloss (Gloss Level 2), MPI #153.
- B. Gypsum Board and Plaster Substrates:
  - 1. Latex System:
    - a. Prime Coat: Primer sealer, latex, interior, MPI #50.
    - b. Intermediate Coat: Latex, interior, matching topcoat.
    - c. Topcoat at Ceilings: Latex, interior, flat, (Gloss Level 1), MPI #53.
    - d. Topcoat at all Walls: Latex, interior, eggshell, (Gloss Level 2), MPI #44.
- C. Interior Wood Substrates:
  - 1. Water-Based Varnish over Stain System:
    - a. Stain Coat: Stain, semitransparent, for interior wood, MPI #90.
      - 1) PPG; Olympic Premium Interior Oil Based Wood Stain.
      - 2) Sherwin Williams; Minwax Interior Oil Stain-250.

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- b. First Intermediate Coat: Water-based varnish matching topcoat.
- c. Second Intermediate Coat: Water-based varnish matching topcoat.
- d. Topcoat: Varnish, water based, clear, gloss (MPI Gloss Level 6), MPI #130.
  - 1) Benjamin Moore; Benwood Acrylic Polyurethane High Gloss.
  - 2) PPG; Olympic Premium Interior Waterbased Polyurethane Clear.
  - 3) Sherwin Williams; Minwax Polycrylic Protective Finish Gloss.

END OF SECTION 099123

SECTION 101100 – VISUAL DISPLAY UNITS

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. Visual display board assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, finishes, and accessories for visual display units.
- B. Shop Drawings: For visual display units.
  - 1. Include plans, elevations, sections, details, and attachment to other work.
  - 2. Show locations of panel joints.
- C. Samples for Initial Selection: For each type of visual display unit indicated, for units with factory-applied color finishes, and as follows:
  - 1. Fabric swatches of fabric facings for tackboards.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-fabricated visual display units completely assembled in one piece. If dimensions exceed maximum manufactured unit size, or if unit size is impracticable to ship in one piece, provide two or more pieces with joints in locations indicated on approved Shop Drawings.

1.5 FIELD CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.



PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 75 or less.
  - 2. Smoke-Developed Index: 450 or less.

2.2 VISUAL DISPLAY BOARD ASSEMBLY

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Koroseal; Walltalkers Tac-Wall or approved equal by architect.
- B. Visual Display Board Assembly: Factory fabricated.
  - 1. Assembly: Tackboard.
  - 2. Corners: Square.
  - 3. Width: As indicated on Drawings.
  - 4. Height: As indicated on Drawings.
  - 5. Mounting Method: Direct to wall.
- C. Tackboard Panel: Linoleum tackboard panel on natural burlap backing.
  - 1. Fabric Wrapped Edge: Wrap edge of tackboard panel with fabric facing.
  - 2. Color and Pattern: As selected by Architect from full range of manufacturer colors.
- D. Joints: Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, as indicated on approved Shop Drawings.

2.3 MATERIALS

- A. Adhesives for Field Application: Mildew-resistant, nonstaining adhesive for use with specific type of panels, sheets, or assemblies; and for substrate application; as recommended in writing by visual display unit manufacturer.
- B. Primer/Sealer: Mildew-resistant primer/sealer complying with requirements recommended in writing by visual display unit manufacturer for intended substrate.

2.4 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

**PART 3 - EXECUTION**

**3.1 EXAMINATION**

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display units.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

**3.2 PREPARATION**

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances, such as dirt, mold, and mildew, that could impair the performance of and affect the smooth, finished surfaces of visual display boards.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display units and wall surfaces.
- D. Prime wall surfaces indicated to receive direct-applied, visual display assemblies and as recommended in writing by primer/sealer manufacturer and visual display unit manufacturer.
- E. Back-roll tackable surface material so that it will remain flat and in full contact with adhesive when installed. Allow materials to acclimate to the installation location for a minimum of 24 hours prior to installation.

**3.3 INSTALLATION**

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide adhesives and accessories necessary for complete installation.
- B. Factory-Fabricated Visual Display Board Assemblies: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display board assemblies with fasteners at not more than 16 inches o.c. Secure tops and bottoms of boards to walls.

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### 3.4 CLEANING AND PROTECTION

- A. Clean visual display units in accordance with manufacturer's written instructions. Attach one removable cleaning instructions label to visual display unit in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display units after installation and cleaning.

END OF SECTION 101100

SECTION 101419 – DIMENSIONAL LETTER SIGNAGE

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:
  - a. Cutout dimensional characters.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
  - 3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
- C. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Dimensional Characters: Full-size Sample of each type of dimensional character.
  - 2. Exposed Accessories: Full-size Sample of each accessory type.
- D. Product Schedule: For dimensional letter signs. Use same designations indicated on Drawings or specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Sample Warranty: For special warranty.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:

- a. Deterioration of finishes beyond normal weathering.
  - b. Separation or delamination of sheet materials and components.
2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 DIMENSIONAL CHARACTERS

- A. Cutout Characters: Characters with uniform faces; eased edges; precisely formed lines and profiles; and as follows:
  1. Character Material: Sheet or plate aluminum.
  2. Character Height: As indicated on Drawings.
  3. Thickness: 0.25 inch.
  4. Finishes:
    - a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color matching Architect's sample.
    - b. Overcoat: Manufacturer's standard baked-on clear coating.
  5. Mounting: Concealed studs.
  6. Typeface: Graphik Condensed Black.

### 2.2 DIMENSIONAL CHARACTER MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209 alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

### 2.3 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:
  1. Use concealed fasteners and anchors unless indicated to be exposed.
  2. Exposed Metal-Fastener Components, General:
    - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
    - b. Fastener Heads: For nonstructural connections, use flathead screws and bolts with tamper-resistant Allen-head slots unless otherwise indicated.
  3. Sign Mounting Fasteners:

- a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated.

## 2.4 ALUMINUM FINISHES

- A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION OF DIMENSIONAL CHARACTERS

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 3. 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. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
    - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
    - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.

**3.3 ADJUSTING AND CLEANING**

- A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101419

SECTION 102600 - WALL AND DOOR PROTECTION

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. Corner guards.
- B. Related Requirements:
  - 1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.
- B. Samples for Initial Selection: For each type of impact-resistant wall-protection unit indicated, in each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of wall protection product to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
  - 1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
  - 2. Keep plastic materials out of direct sunlight.
  - 3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
    - a. Store corner-guard covers in a vertical position.



PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 450 or less.
- B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities.

2.3 CORNER GUARDS

- A. Surface-Mounted, Metal Corner Guards <CG-1>: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet; DRMW 625-625 or a comparable product as approved by the Architect.
  - 2. Material: Extruded aluminum, minimum 0.0625 inch thick, with powder coat finish.
  - 3. Color: As selected by Architect from Manufacturer's standard color selection.
  - 4. Wing Size: Nominal 5/8 by 5/8 inches.
  - 5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.
  - 6. Length: Full-height of exposed wall unless otherwise indicated on Drawings.
- B. Surface-Mounted, Metal Corner Guards <CG-2>: Fabricated as one piece from formed or extruded metal with formed edges; with 90- or 135-degree turn to match wall condition.
  - 1. Basis-of-Design Product: Subject to compliance with requirements, provide Fry Reglet; DMCT-1250 or a comparable product as approved by the Architect.
  - 2. Material: Extruded aluminum, minimum 0.0625 inch thick, with powder coat finish.
  - 3. Color: As selected by Architect from Manufacturer's standard color selection.
  - 4. Wing Size: Nominal 1-1/4 by 1-1/4 inches.
  - 5. Mounting: Flat-head, countersunk screws through factory-drilled mounting holes.
  - 6. Length: Full-height of exposed wall unless otherwise indicated on Drawings.

2.4 MATERIALS

- A. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.5 FABRICATION

- A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.
- B. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

2.6 FINISHES

- A. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of the Work.
- B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.
  - 1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Complete finishing operations, including painting, before installing wall and door protection.
- B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

- A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

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3.4 CLEANING

- A. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 200800 – SEISMIC PROTECTION

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 the work of this Section.

1.2 APPLICABILITY

- A. Seismic supports and restraints shall be provided for all Life Safety and Hazardous or Flammable systems. The following are defined as Life Safety and Hazardous or Flammable:
  - 1. Fire protection equipment and systems.
  - 2. Fire suppression piping.
  - 3. Communication and fire alarm systems.
- B. In addition to the above, seismic supports and restraints shall be provided for all of the following systems:
  - 1. Electrical bus ducts and primary cable systems.
  - 2. Piping systems.
  - 3. HVAC ducts.
  - 4. Electrical panelboards.
  - 5. Lighting fixtures.

1.3 EXEMPTIONS

- A. The following mechanical and electrical components are exempt from the requirements of this Section:
  - 1. MEP components that were existing prior to beginning of construction of this project and which are not disturbed during the course of this work, are exempt.
  - 2. Piping and conduit are exempt if the entire run is suspended from 3/8" or 0.5" in diameter rod hangers 12-inches or less in length from the top of the pipe to the supporting structure and the total weight supported by any single rod is 50 lb or less, and if the hangers are sufficient to avoid significant bending of the hangers and their connections.
  - 3. Piping constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 1-inch and smaller, are exempt.
  - 4. Conduit constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 2.5-inch and smaller, are exempt.
  - 5. If not part of Life Safety and Hazardous or Flammable systems, HVAC ducts are exempt if the entire duct run is suspended from 3/8" or 0.5" in diameter rod hangers 12 inches or less in length from the top of the duct to the supporting structure and the total weight supported by any single rod is 50 lb or less, and if the hangers are sufficient to avoid significant bending of the hangers and their connections.
  - 6. If not part of Life Safety and Hazardous or Flammable systems, HVAC ducts are exempt if the entire duct run consists of ducts less than 6 square feet in cross-sectional area or weight 20 lb/ft or less.

- B. There are no further exemptions allowed for Life Safety and Hazardous or Flammable components or systems as defined in the “Applicability” subsection above.
- C. For other than Life Safety and Hazardous or Flammable systems, the following mechanical and electrical components are exempt from the requirements of this Section:
  - 1. If not part of Life Safety and Hazardous or Flammable systems, MEP components weighing less than 20 pounds are exempt if flexible connections are provided between the components and associated ducts, pipes, or conduit.
  - 2. If not part of Life Safety and Hazardous or Flammable systems, MEP components weighing less than 400 pounds are exempt if flexible connections are provided between the components and associated ducts, pipes, or conduit, and if the component is mounted at 48 inches or less above finished floor level.
  - 3. If not part of Life Safety and Hazardous or Flammable systems, piping constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 3-inch and smaller, is exempt.
  - 4. If not part of Life Safety and Hazardous or Flammable systems, conduit constructed of steel, copper, ductile iron, aluminum, or plastic, of nominal diameter 2.5-inch and smaller, is exempt.
  - 5. If not part of Life Safety and Hazardous or Flammable systems, electrical conduits, cable trays, and bus ducts are exempt provided that none of the following apply:
    - a. Supports are cantilevered up from the floor.
    - b. Supports are constructed as rigid welded frames.
    - c. Supports include bracing to limit deflection.
    - d. Attachments into concrete utilize nonexpanding inserts, shot pins or cast iron embedments or attachments utilizing spot welds, plug welds, or minimum size welds (as defined in AISC LRFD).
- D. Any otherwise-exempt MEP component, whose failure in an earthquake would potentially damage a non-exempt component, is non-exempt. Example: An exempt storm drain pipe mounted above a non-exempt natural-gas pipe could fall and rupture the gas pipe. Therefore, the storm drain pipe must be treated as non-exempt.

#### 1.4 SUMMARY

- A. Description of Work: The purpose of this section is to define seismic restraint requirements for mechanical and electrical systems, equipment and devices, hereinafter referred to as components.
- B. This Section does not specify seismic force resisting systems for building structures and structural elements, which are addressed in Divisions 03 through 06.
- C. The requirements for seismic protection specified herein are in addition to any requirements for support and/or seismic protection specified in other sections of these specifications.
- D. The Contractor shall be responsible for developing details to provide proper support of equipment and devices in accordance with the requirements specified herein.
- E. The Contractor shall not proceed with installation of equipment nor seismic protection system until

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all applicable submittals required by this section have been completed.

F. This section includes the following:

1. Applicable Code.
2. Project-specific Code Coefficients
3. Rigid Support Items.
4. Non-rigid Support Items.
5. Sway Braces.
6. Anchors, Bolts and Clamps.
7. Restraining Cables.
8. Seismic Snubbers.
9. Installation Requirements.

G. Related sections: The following sections contain requirements that relate to this section:

1. Division 05 Section “Metal Fabrications” for materials to anchor equipment piping to building structure.
2. Division 07 Section “Roof Accessories” for roof equipment supports.
3. Division 09 Sections “Interior Painting” and/or “Exterior Painting” for field-applied painting requirements.
4. Division 23 Section “Basic Mechanical Materials and Methods” for general mechanical requirements.
5. Division 23 Section “Hangers and Supports” for piping and equipment supports.
6. Division 23 Section “Mechanical Vibration Isolation” for vibration-isolation hangers, supports and flexible connectors.
7. Division 23 Section “Mechanical Insulation” for pipe, duct, and equipment insulation.
8. Division 26 Section “Common Work Results for Electrical” for general electrical requirements.
9. All Division 21 to 28 Sections for mechanical and electrical equipment and systems requiring seismic protection.

## 1.5 DEFINITIONS

- A. Terminology used in this section is defined in ASCE/SEI 7-16: *Minimum Design Loads for Buildings and Other Structures*, as issued by the American Society of Civil Engineers, 2017; Reston, Virginia.
- B. OSHPD: Office of Statewide Health Planning & Development for the State of California.

## 1.6 PERFORMANCE REQUIREMENTS

- A. This facility is designated as Risk Category III.
- B. The spectral response acceleration at short periods,  $S_s$ , shall be taken as 0.162g.
- C. The spectral response acceleration at one-second period,  $S_1$ , shall be taken as 0.094g.
- D. This facility site is designated as Site Class Definition D.

- E. The Site Coefficients,  $F_a$  shall be taken as 1.6 and  $F_v$  shall be taken as 2.4.
- F. SDS, the Five-Percent damped design spectral response acceleration at short periods, shall be taken as  $SDS = 0.173$ .
- G. SDI, the Five-Percent damped design spectral response acceleration at one-second period, shall be taken as  $SDI = 0.151$ .
- H. This facility is designated as Seismic Design Category C.
- I. The horizontal seismic force on a given component shall be noted as  $F_p$ . The seismic force  $F_p$  shall be applied at the center of gravity, independently longitudinally and laterally in combination with service loads associated with the component. The following equation shall be utilized individually on every component to determine  $F_p$ :
  - 1.  $F_p = 0.64 \times I_p \times W_p$  where
    - a.  $I_p$  = Component Importance Factor.
    - b.  $W_p$  = Component Operating Weight in pounds.
  - 2. In lieu of the above equation, a much more detailed calculation involving Equation 13.3-1 of ASCE 7-16 and its related Tables, which may yield somewhat lower results for  $F_p$ , may be utilized. If this option is selected, complete details of all such calculations shall be submitted as required under "Submittals" below.
- J. The vertical seismic force on a given component shall be taken as  $0.08 \times W_p$  and shall be determined individually for every component. This vertical force shall be applied at the center of gravity of the component, in either vertical direction, and shall be considered concurrent with the horizontal force determined above.

## **1.7 SUBMITTALS**

- A. The Engineer shall receive one copy of all submittal data supplied to the Owner as required in this specification. It is the responsibility of the Contractor to provide seismic protection as outlined herein. Receipt by the Engineer of a copy of the submittals is to verify conformance to the submittal requirements set forth in this specification section. It is not an admission by the Engineer as to the accuracy or completeness of the calculations submitted and equipment proposed.
- B. Prior to installation of equipment and devices requiring seismic restraints, the Contractor shall submit required documentation and details at the shop drawing review stage to the Owner. Submit the following in accordance with conditions of contract and Division 01 specification sections.
- C. Product data: Include installation details and instructions for each type of seismic support and restraint. Submit equipment support and restraint schedule showing size, location, and features for each required support and restraint.
- D. Product certificates: Signed by the manufacturer of seismic supports and restraints certifying that their products meet the specified requirements.

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- E. Shop Drawings: Calculations and Drawings signed and sealed by a qualified professional engineer registered to practice in the State of Missouri, shall be provided for the installation details of each piece of equipment. Include the following:
1. Design Calculations: Calculate requirements for selecting seismic restraints. Exception: Certified and stamped calculations are not required for seismic-restrained systems which have been pre-approved by OSHPD or comply with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition; except where more stringent requirements are described herein. A signed letter on Contractor’s letterhead shall be provided as part of the submittal process stating which approved systems are being utilized.
  2. Seismic-Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.
  3. Assembly-type shop drawings: For each type of seismic support and restraint, indicate dimensions, weights, required clearances, and methods of assembly of components. Submittal Drawings shall indicate in complete detail size, type, material grade, locations and dimensions; and shall show construction details, reinforcement, anchorage and installation with relation to the building construction. Submittals shall include, but not be limited to sway braces, flexible couplings or joints, resilient type vibration devices, and anchorage of concrete equipment pads to structure.
  4. Where seismic anchors and braces for one component must unavoidably be attached to two or more elements of a structure subject to differential movement, such as a wall and a floor or two different floors, submit sealed calculations for relative displacements; including selection of sufficient flexible fittings to accommodate the relative displacement. Examples subject to relative displacement include vertical pipe or conduit risers; or a pump anchored to a floor and rigidly connected to piping anchored to the roof structure above.
- F. Welder certificates: Signed by Contractor certifying that welders comply with requirements specified under “Quality Assurance” Article.
- G. Maintenance data: For seismic supports and restraints for inclusion in Operating and Maintenance Manual specified in Division 01, Division 23 Section “Basic Mechanical Requirements” and Division 26 Section “Common Work Results for Electrical.”
- H. Manufacturer Seismic Qualification Certification: Submit certification that all specified equipment will withstand seismic forces identified in “Performance Requirements” Article above. Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations. The term “withstand” means “the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event.”
  2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- I. Contractor’s Acknowledgement of Seismic Responsibility: Submit written contractor’s statement of responsibility prior to commencement of the work, acknowledging an awareness of the seismic



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restraint requirements of the project, that control will be exercised to obtain conformance with the Construction Documents, listing procedures for exercising control over the seismic restraint installation, and identifying the responsible person(s) within their organization.

**1.8 QUALITY ASSURANCE**

- A. Seismic-restraint devices shall have horizontal and vertical load testing and analysis performed according to OSHPD and shall bear anchorage preapproval “R” number, from OSHPD or another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. 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) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to the weakest mode.
- B. Qualify welding processes and welding operators in accordance with AWS D1.1 “Structural Welding Code – Steel.” Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

**1.9 REFERENCES**

- A. Regulatory Requirements: Comply with applicable codes pertaining to product materials and installation of seismic supports and restraints.
- B. Referenced Codes and Standards: All work provided under this section shall comply with the requirements specified herein, and additionally as provided in the following Codes and Standards. In all cases where conflicting requirements are provided within these specifications, Codes and Standards, the most stringent requirement shall apply.
- C. IBC 2021: Comply with the International Building Code Chapters 16 and 17.
- D. ASCE/SEI 7-16: Comply with *Minimum Design Loads for Buildings and Other Structures*, as issued by the American Society of Civil Engineers, 2017; Reston, Virginia.
- E. NFPA Compliance: Seismic supports and restraints shall comply with NFPA Standard 13 when used as a component of a fire protection system.
- F. UL and FM Compliance: Seismic supports and restraints shall be listed and labeled by UL and FM where used for fire protection piping systems
- G. ANSI/SMACNA: All seismic restraints for piping and ductwork shall comply with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition. A seismic hazard level (SHL) shall be utilized as scheduled below.
  - 1. All Fire Protection/Suppression Piping: SHL - A
  - 2. All other ductwork not listed above: SHL - B
  - 3. All other Piping not listed above: SHL - B
- H. ANSI Standards and ASTM Publications: Seismic supports and restraints shall comply with American National Standards Institute, Inc. (ANSI) and the American Society for Testing and

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Materials (ASTM) Publications.

1.                    Square and Hex Bolts and Screws Inch Series  
    B18.2.1-1981
  2.    B18.2.2-1972    Square and Hex Nuts (R1983)
  3.    A36-84a         Structural Steel
  4.    A307-86a       Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
  5.    A325-86a       High-Strength Bolts for Structural Steel Joints
  6.    A501-84         Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
  7.    A576-87         Steel Bars, Carbon, Hot-Wrought, Special Quality
- I. Federal Specification: Seismic supports and restraints shall comply with Federal Specification RR-W-410D for Wire Rope and Strand.

**1.10    EXTRA MATERIALS**

- A. Furnish extra replacement neoprene inserts for all snubbers, which match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

**PART 2 - PRODUCTS**

**2.1       MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1.    California Dynamics Corp.
  2.    Eaton; Cooper, B-Line, and Tolco brands.
  3.    Kinetics Noise Control, Inc.
  4.    Loos & Co., Inc.
  5.    Mason Industries, Inc.
  6.    Unistrut Corp.; division of Tyco International, Ltd.
  7.    Vibration Eliminator Co., Inc.
  8.    Vibro-Acoustics, Inc.
  9.    The VMC Group; Amber/Booth, Korfund, and VMC brands.
- B. All seismic restraint devices of any one general group; raceways or suspended equipment, or switchgear or other floor mounted equipment, etc., shall be provided by a single manufacturer.

**2.2       MATERIALS**

- A. Steel Plates, Shapes, and Bars: ASTM A36.
- B. Bolts and Nuts: Square and hex bolts and nuts, ANSI B18.2.1 and B18.2.2, SAE Grade 5, and ASTM A307 or A325.
- C. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.
- D. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

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- E. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
  - F. 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 E488. Minimum length of eight times diameter.
  - G. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.
  - H. Sway Brace: Material used for members listed in Table I of this specification, except for pipes, shall be structural steel conforming with ASTM A36. Steel pipes shall conform to ASTM A501. Note additional exception below.
    - 1. Contractor's Option: In lieu of utilizing angles, rods, bars or pipes as noted in Table I, U-channel systems consisting of channels, fittings and accessories may be utilized. The u-channel system shall be manufactured as a complete system by one supplier and listed by the manufacturer for use in seismic restraint application. The system shall have the approval of OSHPD. The equipment shall provide multi-directional bracing of electrical conduit, cable tray and mechanical piping/ductwork systems.

TABLE I  
MAXIMUM LENGTH AND ALLOWABLE CONCENTRIC LOADS FOR SWAY BRACES

Type	Size (inches)	Maximum Length*	Allowable Concentric Load* (kips)
Angles	1½ x 1½ x ¼	4'-10"	3.4
	2 x 2 x ¼    6'-6"	4.6	
	2½ x 2½ x ¼	8'-2"	5.9
	3 x 3 x ¼    9'-10"	7.1	
Rods	¾	3'-1"	2.2
	7/8	3'-7"	3.0
Pipes (40S)	1	6'-9"	2.4
	1¼	8'-8"	3.3
	1½	10'-1"	3.9
	2	12'-9"	5.3
	2½	15'-4"	8.4
	3	19'-0"	11.0

\*Based on the slenderness ratio of  $1/r = 200$ , and load applied concentrically to brace. The tabulated load values include a 33% stress increase as permitted for seismic loads. For non-concentric loading, allowable brace load is to be determined per the AISC Specification for Structural Steel Buildings / ASD 1989.

- I. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod. Reinforcing steel angle clamped to hanger rod is also acceptable.
- J. Restraining Cables: ASTM A603 galvanized steel aircraft cables of minimum diameter 1/8-inch, with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Cables shall conform to Fed. Spec RR-W-410 as follows:
  - 1. Less than 1/8-inch diameter    Not Permitted
  - 2. 1/8 to 5/32 inch diameter    Type V, Class 1
  - 3. 3/16 inch to 5/16 diameter    Type V, Class 2
  - 4. 1/4 inch to 5/8 diameter    Type I, Class 2
- K. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- L. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.
  - 1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
  - 2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
  - 3. Maximum ¼-inch (6-mm) air gap, and minimum ¼-inch- (6-mm-) thick resilient cushion.

- M. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- N. Flexible Couplings: Flexible couplings shall have same pressure ratings as adjoining pipe.
- O. Cement Grout: Portland cement (ASTM C150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration. P. Non-shrink, Nonmetallic Grout: ASTM C1107, Grade B.
  - 1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.
- Q. Galvanizing Repair Paint: High-zinc-dust-content paint, with dry film containing not less than 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive seismic-control devices for compliance with requirements, installation tolerances, and other conditions affecting performance. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation. Examine substrates and conditions under which seismic supports and restraints are to be installed.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SEISMIC PROTECTION, GENERAL

- A. Attachments and supports for mechanical and electrical systems and components shall be designed to resist the seismic forces specified herein.
- B. Mechanical and electrical systems and components shall be designed by their manufacturer to consider dynamic effects of the equipment and its contents. Design, selection, and installation of seismic bracing for mechanical and electrical systems and components shall account for interaction between equipment and supporting structures, and the effect imposed by attached utility or service lines, and shall ensure that impact between components is avoided during a seismic event.
- C. Anchorage: Install seismic supports and restraints complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
  - 1. Friction resulting from gravity loads shall not be considered to provide resistance to seismic

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- loads.
2. All bolts, including fasteners and anchor bolts, used for attachment of anchors to components and to structure shall be sized for the seismic forces described in Part I but shall not be less than ½-inch diameter in any case.
  3. Powder-driven fasteners and shot pins shall not be permitted in tension load applications.
  4. Expansion anchors, other than undercut expansion anchors, shall not be permitted to anchor non-vibration isolated equipment rated over 10 horsepower.
  5. Anchorage Embedment Depth: Not less than eight times the anchorage diameter.
  6. Anchorage Edge Distance: Place anchorage not less than ten times the anchorage diameter from edge of concrete housekeeping pad.
- D. Base-Mounted Equipment: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions for seismic forces at Project site.
1. Concrete equipment pads shall be anchored to the supporting structure as required to resist the seismic loads specified herein. Anchorage shall adequately distribute loads to the elements of the supporting structure; coordinate with building structural engineer if required. Anchorage devices may consist of either cast-in-place or drilled-in and epoxy grouted reinforcing steel dowels. Unless otherwise indicated, install dowel rods to connect concrete base to concrete floor on 18-inch (450-mm) centers around the full perimeter of the base.
  2. All floor or pad mounted equipment shall be anchored with cast-in-place anchor bolts, expansion bolts or epoxy bolts. For vibratory equipment, the nuts shall be secured against loosening by either installing double nuts, tack welding single nut to bolt or scoring bolt threads.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  7. Cast-in-place concrete materials and placement requirements are specified in Division 03.
- E. Resilient Vibration Isolation Devices: Selection of anchor bolts for vibration isolation devices and/or snubbers to equipment base and foundations shall follow the same procedure as for base mounted equipment in subsection above, except that the seismic force found in Part 1 shall be doubled for the purpose of selecting isolation devices, anchorage, and snubbers.
1. Vibration Isolation Devices are suitable for seismic restraint provided the vertical and horizontal seismic forces are within the limits designed into the device.
  2. Resilient and Spring-Type Vibration Devices: Vibration isolation devices shall be selected so that the maximum movement of equipment from the static deflection point shall be 0.5 inches.
  3. Multi-directional Seismic Snubbers: If vibration isolators are required, then multi-directional seismic snubbers employing elastomeric pads shall be installed on all vibration isolated equipment. These snubbers shall provide 0.25-inches free vertical and horizontal movement from the static deflection point. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure. Snubber medium

shall consist of viscoelastic or other impact-limiting material arranged around a flanged steel trunnion so both horizontal and vertical overturning forces are resisted by the snubber medium.

4. Install resilient bolt isolation washers on equipment anchor bolts.
  5. Do not short-circuit vibration isolation device with rigid connection directly to structure.
- F. Equipment Sway Bracing: Required for all items supported from overhead structures. Braces shall consist of angles, rods, bars, pipes, cables, or factory fabricated U-channel systems and secured at both ends with not less than ½-inch bolts. Braces shall conform to Table 1, or as recommended by U-channel systems fabricator. Bracing shall be provided in two planes of directions, 90 degrees apart, for each item of equipment. Details of all equipment bracing shall be submitted.
1. In lieu of bracing with vertical supports, these items may be supported with hangers inclined at 45 degrees directed up and radially away from equipment and oriented symmetrically in 90-degree intervals on the horizontal plane, bisecting the angles of each corner of the equipment, provided that supporting members are properly sized to support operating weight of equipment when hangers are inclined at a 45-degree angle.
  2. Exception: Components mounted in line with duct systems and which weigh less than 75 pounds, do not require dedicated equipment sway bracing. Instead, such components shall be considered a part of the duct system itself and braced as such.

### 3.3 PIPES AND DUCTS

- A. General: Select and install restraints for piping and ductwork in complete and strict accordance with ANSI/SMACNA Standard 001-2008 *Seismic Restraint Manual; Guidelines for Mechanical Systems*, as issued by the Sheet Metal and Air Conditioning Contractors National Association, Inc., 2008; Chantilly, Virginia; Third Edition; except where more stringent requirements are described herein.
- B. Fire protection sprinkler systems shall be seismically braced in accordance with NFPA 13; however, the seismic force calculated per NFPA 13, when multiplied by 1.4, shall not be less than that required by this Specification.
- C. Conduit: Restraints for piping shall also apply to conduit.
- D. Transverse Sway Bracing: Transverse sway bracing shall be provided at each horizontal turn of 45 degrees or more, at the end of each pipe/duct run, and otherwise at regular intervals spaced no further than required by the above Standard. Walls which ducts penetrate may be considered transverse braces. Sway bracing shall be provided at closer intervals if so recommended by U-channel manufacturer when using U-channel systems.
- E. Longitudinal Sway Bracing: Longitudinal sway bracing shall be provided at regular intervals spaced no further than required by the above Standard. Transverse bracing for one pipe/duct section may also act as longitudinal bracing for a pipe/duct section connected perpendicular to it, if the bracing is installed within 4 feet of the intersection, and if it is sized for the larger pipe/duct. Sway bracing shall be provided at closer intervals if so recommended by U-channel manufacturer when using U-channel systems.
- F. All equipment installed in line with ductwork, including but not limited to fans, humidifiers, heat exchangers, air terminal units, etc., and which have an operating weight greater than 75 pounds,

shall be supported and sway braced independently of the duct system. Appurtenances lighter than 75 pounds, including but not limited to diffusers, dampers, louvers, grilles, etc., shall be positively attached to the ducts with mechanical fasteners.

- G. Anchor Rods, Angles, and Bars: Anchor rods, angles, and bars shall be bolted to either pipe clamps or pipe flanges at one end and cast-in-place concrete or masonry insert or clip angles bolted to the steel structure on the other end. Rods shall be solid metal or pipe as required.
- H. Restraining Cables: Install restraining cables slightly slack. Install cables so they do not bend across sharp edges of adjacent equipment or building structure.
- I. Hanger Rod Reinforcement: Install steel angles or channel, sized to prevent buckling, clamped with ductile-iron clamps to hanger rods for trapeze and individual pipe and equipment hangers where required. Do not weld angles to rods.
- J. Clamps: Clamps on uninsulated pipes shall be applied directly to pipes. Insulated piping shall have clamps applied over insulation vapor barrier with high-density inserts and metal protection shields under each clamp. Vapor barrier shall not be punctured. At trapeze anchor locations, shackle or clamp piping to trapeze.
- K. Vertical Runs: Vertical runs of piping or ductwork shall be braced at each floor and roof level. Provide intermediate lateral braces at 13 foot maximum spacing where story height exceeds 13 feet.
- L. Spreaders: Required between racked or adjacent piping runs to prevent contact during seismic activity whenever pipe or insulated pipe surfaces are less than 4 inches (or four times the maximum displacement due to seismic force) apart. Spreaders shall be applied at same interval as sway braces. Spreaders shall be applied to surface of bare or insulated hot pipe, and over insulation utilizing high-density inserts and pipe protection shields where vapor-barrier-type insulation is employed.
- M. Flexible Couplings or Joints: Flexible couplings and joints of the mechanical joint type may be used for aboveground piping. Flexible couplings or joints in building piping shall be provided at bottom of all pipe risers larger than 3½ inches in diameter.
- N. Mechanical couplings for steel or cast-iron pipe shall be of the sleeve type and shall provide a tight flexible joint under all reasonable conditions, such as pipe movement caused by expansion, contraction, slight settling or shifting of the ground, minor variations in trench gradients, and traffic vibrations. Where permitted in other sections of these specifications, joints utilizing split-half couplings with grooved or shouldered pipe ends may be used.
- O. Sleeve-type couplings shall be used for joining plain-end pipe sections. The coupling shall consist of one steel middle ring, two steel followers, two gaskets, and necessary steel bolts and nuts to compress the gaskets. Underground bolts shall be galvanized.

### **3.4 ELECTRICAL EQUIPMENT**

- A. Electrical Equipment Bases: Oversized washers and/or reinforcing stiffeners extending to the equipment wall are required at bolted connections through the base, for any equipment bases not designed to transfer seismic loads.



- B. Internal coils of dry type transformers shall be positively attached to their supporting structure within the transformer.
- C. Slide-out components in electrical control panels, computer equipment, etc. shall have a latching mechanism to hold contents in place.
- D. Cutouts in the lower shear panel of electrical cabinets are prohibited, unless one of the following exceptions is met:
  - 1. Factory cutouts made by the manufacturer.
  - 2. Cutouts supported by an analysis demonstrating that remaining cabinet strength is sufficient.
- E. Attachment of additional external items to electrical equipment is prohibited, unless one of the following exceptions is met:
  - 1. Items weighing less than 100 pounds.
  - 2. Items provided by the electrical equipment manufacturer.
  - 3. Items shown by analysis demonstrating their effects are supported by the design.

**3.5 LIGHTING FIXTURES**

- A. Lighting fixture supports shall be malleable iron unless specified to be of a higher quality (such as stainless steel, etc.) in other sections of these specifications.
- B. A supporting assembly that is intended to be mounted on an outlet box shall be designed to accommodate mounting features on 4-inch boxes, 3-inch plaster rings, and fixture studs.
- C. Wall-mounted emergency light unit shall be secured in a manner to hold the unit in place during a seismic disturbance.
- D. Pendant Fixtures: Loop and hook or swivel hanger assemblies shall be fitted with a restraining device to hold the stem in the support position during earthquake motion. Pendant-supported fluorescent fixtures shall also be provided with a flexible hanger device at the attachment to the fixture channel to preclude breaking of the support. The motion of swivels or hinged joints shall not cause sharp bends in conductors or damage to insulation.
- E. Chain Hung Fixtures: Support from each corner directly to ceiling structure above. Secure chain to fixture and ceiling with bolted connections.
- F. Cable Hung Fixtures: Support by a pre-manufactured and pre-certified cable hanger system. A typical support shall include a ceiling connector (anchor, eyebolt, etc.), a stainless steel 3/32" or thicker cable (length as required) and a fixture connector flange assembly. The fixture connector assembly shall be secured to the fixture housing with two screws. A typical 1' x 4' fixture shall require two supports, one at each end of the fixture.
- G. Recessed fluorescent individual or continuous-row fixtures: Support by a seismic-resistant suspended ceiling support system. Except where restricted below, the fixtures shall be bolted, screwed or riveted to the ceiling system runners at each corner of the fixture. In addition, provide

with fixture support wires attached to the building structural members using two wires for individual fixtures and one wire per unit of continuous row fixtures.

1. All lighting fixtures over 56 pounds in weight shall be attached to building structural members utilizing fixture support wires.
2. All recessed fixtures 4 s.f. or more in area in the horizontal plane shall also be secured with two wires as described in Division 26 Section "Interior Lighting."

### **3.6 CEILING-MOUNTED COMPONENTS**

- A. Definition: For the purpose of this section, a ceiling-mounted component includes but is not limited to lighting fixtures. In addition, ceiling components also include speakers, grilles and diffusers, radiant heating panels, fire alarm devices, occupancy detectors and the like.
- B. All ceiling-mounted components weighing 10 pounds (4.5 kg) or less shall have a #12 hanger wire attached to the component and to the structure above. The wire need not be taut. At the housing, loop the wire through an eye on the component housing and wrap a minimum of four times around itself. Install with a minimum of slack so that the wires do not exert significant pressure on the component and no pressure on the ceiling that would cause ceiling distortion.
- C. For ceiling-mounted components weighing more than 10 pounds (4.5 kg) but less than or equal to 56 pounds (25.4 kg), two #12 hanger wires shall be wire attached to the component and to the structure above. The wires need not be taut. At the housing, loop the wire through eyes on the component housing, one at each diagonal corner (for rectangular components) and wrap a minimum of four times around itself. Install with a minimum of slack so that the wires do not exert significant pressure on the component and no pressure on the ceiling that would cause ceiling distortion.
- D. For ceiling-mounted components weighing more than 56 pounds (25.4 kg), the component and any attachments shall be supported directly from the structure.

### **3.7 ARCHITECTURAL COMPONENTS**

- A. Seismic bracing of non-structural architectural components (e.g., exterior curtainwalls, interior partitions, storage racks, veneers, cabinets, signs, appendages and ornamentations, etc.) shall be in accordance with the prescriptive requirements of Article 13.5 of ASCE/SEI 7-16.

### **3.8 SUSPENDED ACOUSTICAL CEILING ASSEMBLIES**

- A. All suspended ceiling systems shall be designed to withstand required seismic loads as specified in Part I of this Section. When calculating the force  $F_p$ , the ceiling weight shall include its own weight, plus the weight of all lighting fixtures, air devices and other ceiling-mounted components unless supported entirely independently of the ceiling system. In no case shall the weight of the ceiling be taken as less than 4.0 psf.

### **3.9 SEISMIC RELATIVE DISPLACEMENT**

- A. Do not attach seismic anchorage or bracing for any one component to two or more elements of a structure subject to differential movement, such as a wall and a floor or two different floors. Do

not attach seismic anchorage or bracing for any one component to two or more separate structures or structural systems.

- B. Piping, conduit, ductwork, cable tray, etc. shall be designed to accommodate differential movement between components and structures when attached to structures that could displace relative to each other and where the components cross a seismic isolation interface. Examples include vertical pipe or conduit risers; or a pump anchored to a floor and rigidly connected to piping anchored to the roof structure above. Furnish and install sufficient flexible fittings to accommodate the relative displacement.

**3.10 ADJUSTING**

- A. Adjustment: Adjust supports and restraints to distribute loads equally on attachments. Adjust snubbers according to manufacturer's written recommendations. Adjust seismic restraints to permit free movement of equipment within normal mode of operation.
- B. Torque anchor bolts according to equipment manufacturer's written recommendations to resist seismic forces.

**3.11 CLEANING**

- A. After completing equipment installation, inspect seismic-control devices. Remove paint splatters and other spots, dirt, and debris.
- B. Paint Touch-Up: Immediately after installation of equipment, devices and seismic protection system; clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas per requirements in Division 09 painting sections.
- C. Galvanizing Touch-Up: Immediately after installation of equipment, devices and seismic protection system; clean field welds, bolted connections, and abraded areas of galvanizing. Apply galvanizing repair paint to comply with ASTM A780.

**3.12 FIELD QUALITY CONTROL**

- A. Review: The Owner will engage an independent special inspection agent to review seismic restraint submittals and to perform the following field quality control review:
  - 1. Examine all mechanical and electrical systems and equipment to confirm all seismic restraint systems are installed properly and in compliance with these specifications and the submittals.
  - 2. Examine all seismic restraints and seismic snubbers for minimum clearances.
  - 3. Examine all cable bracing systems for proper installation, angle of slope, and tension or slack.
- B. Report: The Owner's special inspection agent shall submit a certification report(s) to the Owner's Representative for seismic special inspections to verify the above review and to include the following:
  - 1. Certify that all seismic-restraint systems are installed properly and in compliance with these specifications and the submittals.

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2. Identify those areas that require corrective measures or certify that no corrective measures are necessary.
3. Any changes to the originally submitted seismic restraint designs, such as those due to field coordination, shall be clearly defined and detailed in the report.

END OF SECTION 200800

SECTION 210500 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

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. Piping materials and installation instructions common to most piping systems.
  - 2. Mechanical sleeve seals.
  - 3. Sleeves.
  - 4. Escutcheons.
  - 5. Coordination drawings.
  - 6. Project record drawings.
  - 7. Equipment installation requirements common to equipment sections.
  - 8. Painting and finishing.
  - 9. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- D. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- E. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

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## 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Mechanical sleeve seals.
  - 2. Escutcheons.
- B. Welding certificates.

## 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Electrical Characteristics for Fire-Suppression Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for fire-suppression installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for fire-suppression items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Sequence, coordinate, and integrate installations of fire suppression materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.

- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.

**1.8 SCHEDULING AND PHASING**

- A. All fire suppression work shall be scheduled to meet project completion data. Fire suppression work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps as required to support phasing.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
  - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

**2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 21 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

**2.3 JOINING MATERIALS**

- A. Refer to individual Division 21 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Acceptable Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc. (LINK SEAL)
  - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.5 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

2.6 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated or Rough brass.
- C. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.



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- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- F. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- G. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.7 COORDINATION DRAWINGS

- A. The Contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
  - 1. Fire suppression piping routing including locations of valves, drops to sprinkler heads, risers, etc.
  - 2. Fire suppression equipment locations and clearances required.
- B. The Contractor shall submit the CAD generated drawings to HVAC contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by HVAC Contractor.
- C. The Contractor shall participate in coordination meetings when requested by HVAC Contractor.

## 2.8 PROJECT RECORD DRAWINGS

- A. Drawings shall be furnished in electronic-media (CD-Rewritable type) and at least one hard copy prints.
  - 1. Format: Same CAD program, version and operating system as the original Contract Drawings.
  - 2. Incorporate changes and additional information previously marked on Record prints. Delete, re-draw and add details and notations where applicable.
- B. Identify and date each drawing and include the designation "PROJECT RECORD DRAWINGS" or "AS-BUILT DRAWING" in a prominent location.

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 21 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
- Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- R. Verify final equipment locations for roughing-in.
- S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### 3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 21 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

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- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.3 PAINTING

- A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

END OF SECTION 210500

SECTION 211313 - WET-PIPE SPRINKLER 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. Pipes, fittings, and specialties.
  - 2. Fire-protection valves.
  - 3. Sprinklers.
  - 4. Pressure gages.

1.3 DEFINITIONS

- A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.5 PERFORMANCE REQUIREMENTS

- A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.
- B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
  - 1. Contractor shall obtain fire-hydrant flow test records from authorities having jurisdiction.
- C. Sprinkler system design shall be approved by Engineer and authorities having jurisdiction.
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications According to NFPA 13 Unless Otherwise Noted:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Business Occupancy: Light Hazard
    - d. General Storage Areas: Ordinary Hazard, Group 2.
    - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - f. Office and Public Areas: Light Hazard.
    - g. Restaurant Service Areas: Ordinary Hazard, Group 1.
  
  3. Minimum Density for Automatic-Sprinkler Piping Design According to NFPA 13 Unless Noted Otherwise:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
    - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
    - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.
  
  4. Maximum Protection Area per Sprinkler According to NFPA 13 Unless Noted Otherwise:
    - a. Office Spaces and Classrooms: 225 sq. ft.
    - b. Storage Areas: 130 sq. ft.
    - c. Mechanical Equipment Rooms: 130 sq. ft.
    - d. Electrical Equipment Rooms: 130 sq. ft.
    - e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.
  
  5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
    - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
  
  - D. Seismic Performance: Sprinkler piping shall withstand the effects of earthquake motions determined according to NFPA 13 and ASCE/SEI 7.
- 1.6 SUBMITTALS
- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
  - B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
    1. Wiring Diagrams: For power, signal, and control wiring.

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- C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- D. Coordination Drawings: Sprinkler systems, drawn to minimum ¼" scale, on CAD generated drawings. Refer to Section "Common Work Results for Fire Suppression".
- E. Qualification Data: For qualified Installer.
- F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by the Engineer, including hydraulic calculations.
- G. Welding certificates.
- H. Fire-hydrant flow test report.
- I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."
- J. Field quality-control reports.
- K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:
  - 1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- 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. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

## 1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies. Refer to Section "Common Work Results for Fire Suppression" for details.

1.9 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. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

- A. Standard Weight, Black-Steel Pipe: ASTM A 53, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.
- B. Schedule 40, Black-Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 40 in NPS 6 and smaller.
- C. Standard-Weight, Black-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53, seamless steel pipe with threaded ends.
- D. Malleable- or Ductile-Iron Unions: UL 860.
- E. Cast-Iron Flanges: ASME B16.1, Class 125.
- F. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.
- G. Steel Welding Fittings: ASTM A 234 and ASME B16.9.
- H. Grooved-Joint, Steel-Pipe Appurtenances:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Victaulic Company.
  - 2. Pressure Rating: 175 psig minimum.
  - 3. Uncoated, Grooved-End Fittings for Steel Piping: ASTM A 47, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
  - 4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.



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- I. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.

## 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.
  1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
  2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

## 2.4 LISTED FIRE-PROTECTION VALVES

- A. General Requirements:
  1. Valves shall be UL listed or FM approved.
  2. Minimum Pressure Rating for Standard-Pressure Piping: 175 psig.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Anvil International, Inc.
  2. Crane Co.
  3. Globe Fire Sprinkler Corporation.
  4. Metraflex, Inc.
  5. Milwaukee Valve Company.
  6. Mueller Co.; Water Products Division.
  7. NIBCO INC.
  8. Potter Roemer.
  9. Reliable Automatic Sprinkler Co., Inc.
  10. Tyco Fire & Building Products LP.
  11. Victaulic Company.
  12. Viking Corporation.
  13. Watts Water Technologies, Inc.
- C. Ball Valves:
  1. Standard: UL 1091 except with ball instead of disc.
  2. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  3. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  4. Valves NPS 3: Ductile-iron body with grooved ends.
- D. Bronze Butterfly Valves:
  1. Standard: UL 1091.

2. Pressure Rating: 175 psig.
3. Body Material: Bronze.
4. Disc Material: Aluminum bronze.
5. End Connections: Threaded.

E. Iron Butterfly Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron.
4. Disc Material: Aluminum Bronze.
5. Style: Lug or wafer.
6. End Connections: Grooved.

F. Check Valves:

1. Standard: UL 312.
2. Pressure Rating: 250 psig minimum.
3. Type: Swing check.
4. Body Material: Cast iron.
5. End Connections: Flanged or grooved.

G. Bronze OS&Y Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 175 psig.
3. Body Material: Bronze.
4. End Connections: Threaded.

H. Iron OS&Y Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Cast or ductile iron.
4. End Connections: Flanged or grooved.

I. Indicating-Type Butterfly Valves:

1. Standard: UL 1091.
2. Pressure Rating: 175 psig minimum.
3. Valves NPS 2 and Smaller:
  - a. Valve Type: Ball or butterfly.
  - b. Body Material: Bronze.
  - c. End Connections: Threaded.
4. Valves NPS 2-1/2 and Larger:
  - a. Valve Type: Butterfly.
  - b. Body Material: Cast or ductile iron.
  - c. Disc Material: Aluminum bronze.
  - d. End Connections: Flanged, grooved, or wafer.

5. Valve Operation: Integral electrical, 115-V ac, prewired, two-circuit, supervisory switch visual indicating device.

J. NRS Gate Valves:

1. Standard: UL 262.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Cast iron with indicator post flange.
4. Stem: Nonrising.
5. End Connections: Flanged or grooved.

2.5 SPECIALTY VALVES

A. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating:
  - a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.
4. Victaulic Company.
5. Viking Corporation.

C. Automatic (Ball Drip) Drain Valves:

1. Standard: UL 1726.
2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
4. Size: NPS 3/4.
5. End Connections: Threaded.

2.6 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

1. Standard: UL 213.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
4. Type: Mechanical-T and -cross fittings.

5. Configurations: Ductile-iron housing with branch outlets.
6. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
7. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Flow Detection and Test Assemblies:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

C. Branch Line Testers:

1. Standard: UL 199.
2. Pressure Rating: 175 psig.
3. Body Material: Brass.
4. Size: Same as connected piping.
5. Inlet: Threaded.
6. Drain Outlet: Threaded and capped.
7. Branch Outlet: Threaded, for sprinkler.

D. Sprinkler Inspector's Test Fittings:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating: 175 psig minimum.
3. Body Material: Cast- or ductile-iron housing with sight glass.
4. Size: Same as connected piping.
5. Inlet and Outlet: Threaded.

E. Adjustable Drop Nipples:

1. Standard: UL 1474.
2. Pressure Rating: 250 psig minimum.
3. Body Material: Steel pipe with EPDM-rubber O-ring seals.
4. Size: Same as connected piping.
5. Length: Adjustable.
6. Inlet and Outlet: Threaded.

## 2.7 SPRINKLERS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Globe Fire Sprinkler Corporation.
2. Reliable Automatic Sprinkler Co., Inc.
3. Tyco Fire & Building Products LP.

4. Victaulic Company.
5. Viking Corporation.

B. General Requirements:

1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Type: All sprinklers shall be quick response type.
3. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.
3. Painted.

D. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Chrome-plated steel, one piece, flat.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

E. Sprinkler Guards:

1. Standard: UL 199.
2. Type: Wire cage with fastening device for attaching to sprinkler.

2.8 PRESSURE GAGES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. Brecco Corporation.
4. WIKA Instrument Corporation.

B. Standard: UL 393.

C. Dial Size: 3-1/2- to 4-1/2-inch diameter.

D. Pressure Gage Range: 0 to 250 psig.

E. Water System Piping Gage: Include "WATER" or "AIR/WATER" label on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.
- B. Report test results promptly and in writing.

3.2 PIPING INSTALLATION

- A. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.
- B. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.
- C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- D. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.
- G. Install sprinkler piping with drains for complete system drainage.
- H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.
- J. Install alarm devices in piping systems.
- K. Install hangers and supports for sprinkler system piping independent of all other systems according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.
- L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- M. Fill sprinkler system piping with water.

3.3 JOINT CONSTRUCTION

- A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.
- B. Install unions adjacent to each valve in pipes NPS 2 and smaller.
- C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.
- D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- H. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

3.4 VALVE AND SPECIALTIES INSTALLATION

- A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.
- B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.
- C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.
- D. Specialty Valves:
  - 1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.5 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels.

3.6 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
  - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
  - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
  - 4. Bare Piping in Unfinished Service Spaces: One piece, cast brass with rough-brass finish or stamped steel with set-screw or spring clips.
  - 5. Bare Piping in Equipment Rooms: One piece, cast brass stamped steel with set-screw or spring clips.
  - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.7 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements for joint sealants in Division 07 Section "Joint Sealants."
- H. Seal space outside of sleeves in concrete slabs and walls with grout.
- I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.



- J. Install sleeve materials according to the following applications:
1. Sleeves for Piping Passing through Concrete Floor Slabs: Galvanized-steel pipe.
  2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Galvanized-steel pipe.
    - a. Extend sleeves 2 inches above finished floor level.
    - b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements for flashing in Division 07 Section "Sheet Metal Flashing and Trim."
  3. Sleeves for Piping Passing through Gypsum-Board Partitions:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
    - c. Exception: Sleeves are not required for water-supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
  4. Sleeves for Piping Passing through Concrete Roof Slabs: Molded PE or Galvanized-steel pipe.
  5. Sleeves for Piping Passing through Exterior Concrete Walls:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Cast-iron wall-pipe sleeves for pipes NPS 6 and larger.
    - c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.
  6. Sleeves for Piping Passing through Interior Concrete Walls:
    - a. Galvanized-steel-pipe sleeves for pipes smaller than NPS 6.
    - b. Galvanized-steel-sheet sleeves for pipes NPS 6 and larger.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestop materials and installations in Division 07 Section "Penetration Firestopping."

### 3.8 IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.
- B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### 3.9 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Tests and Inspections:

1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Sprinkler systems shall be hydrostatically tested at 200 psi for 2 hours in accordance with NFPA 13.
5. Energize circuits to electrical equipment and devices.
6. Coordinate with fire-alarm tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast-iron threaded fittings; and threaded or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

B. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:

1. Standard-weight, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

D. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 and larger, shall be one of the following:

1. Standard-weight, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.12 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:

1. Rooms without Ceilings: Upright sprinklers.

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2. Rooms with Suspended Ceilings: Concealed sprinklers.
  3. Wall Mounting: Concealed sidewall sprinklers.
  4. Spaces Subject to Freezing: Upright, pendent, dry sprinklers; and sidewall, dry sprinklers as indicated.
  5. Special Applications: Extended-coverage, flow-control, sprinklers where indicated.
- B. Provide sprinkler types in subparagraphs below with finishes indicated.
1. Concealed Sprinklers: Rough brass, with factory-painted cover plate color as directed by Architect.
  2. Upright and Pendent Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION 211313

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SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Project record drawings.
  - 9. Plumbing demolition.
  - 10. Equipment installation requirements common to equipment sections.
  - 11. Painting and finishing.
  - 12. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.

1.5 QUALITY ASSURANCE

- A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the Contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- B. Plumbing work to comply with International Plumbing Code (IPC) as listed on Drawings and General Conditions.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.
- C. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Sequence, coordinate, and integrate installations of plumbing materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- D. Coordinate connection of plumbing systems with exterior underground utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

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- E. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- F. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

## 1.8 SCHEDULING AND PHASING

- A. All plumbing work shall be scheduled to meet project completion date. Plumbing work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps as required to support phasing. Refer to phasing schedule on drawings.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

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- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

## 2.4 TRANSITION FITTINGS

- A. Acceptable Manufacturers:
  - 1. Cascade Waterworks Mfg. Co.
  - 2. Dresser Industries, Inc.; DMD Div.
  - 3. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
  - 4. JCM Industries.
  - 5. Smith-Blair, Inc.
  - 6. Viking Johnson.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Acceptable Manufacturers:
  - 1. Capitol Manufacturing Co.
  - 2. Victaulic Company
  - 3. Calpico, Inc.
  - 4. Epco Sales, Inc.
  - 5. Hart Industries, International, Inc.
  - 6. Lochinvar Corp.
  - 7. Watts Industries, Inc.; Water Products Div.
  - 8. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.



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- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F. Victaulic Style 47.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Acceptable Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Link Seal
    - d. Metraflex Co.
    - e. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Carbon steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- F. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

**2.9 GROUT**

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.

**PART 3 - EXECUTION**

**3.1 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access. In general install piping tight to slab, beams, joists and structural members if possible.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.

- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

- c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
  - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Draining and Refilling of Systems: Provide all shutoff valves, drain valves, pipe, fittings, and miscellaneous material required to drain each existing system as required for new work. After new work is completed, tested, and found tight, refill each system as required. Time for shutting down existing system for draining shall be coordinated with all other work and with Owner's representative. Cost for all chemicals and additives for refill shall be borne by the Contractor.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

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- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

## 3.5 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

## 3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

## 3.7 GROUTING

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout around anchors.
- G. Cure placed grout.

END OF SECTION 220500

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Bronze angle valves.
- 2. Bronze ball valves.
- 3. Bronze swing check valves.
- 4. Bronze globe valves.

B. Related Sections:

- 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
- 2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.
- B. ASME Compliance:
  - 1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
  - 2. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 and NSF-372 (lead free) for valve materials for potable water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
  - 1. Protect internal parts against rust and corrosion.
  - 2. Protect threads, flange faces, grooves, and weld ends.
  - 3. Set 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. Use the following precautions during storage:
  - 1. Maintain valve end protection.
  - 2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

- A. Refer to valve schedule articles for applications of valves.
- B. Valve Pressure and Temperature Ratings: Not less than as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
  - 2. Handwheel: For valves other than quarter-turn types.
  - 3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.



4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every ten (10) plug valves, for each size square plug-valve head.
5. Chainwheel: Device for attachment to valve handwheel, stem, or other actuator; of size and with chain for mounting height, as indicated in the "Valve Installation" Article.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.
2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE ANGLE VALVES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crane Co., Crane Valve Group
2. Hammond Valve.
3. Milwaukee Valve Company.
4. NIBCO Inc.

B. Class 125, Bronze Angle Valves with Bronze Disc:

1. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded.
  - e. Stem and Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron.

C. Class 150, Bronze Angle Valves with Bronze Disc:

1. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 300 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.

- d. Ends: Threaded.
- e. Stem and Disc: Bronze.
- f. Packing: Asbestos free.
- g. Handwheel: Malleable iron.

2.3 BRONZE BALL VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. American Valve, Inc.
- 2. Conbraco Industries, Inc.; Apollo Valves.
- 3. Crane Co.; Crane Valve Group; Crane Valves.
- 4. Hammond Valve.
- 5. Milwaukee Valve Company.
- 6. NIBCO INC.
- 7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

- 1. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Lead Free Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Stainless steel.
  - i. Ball: Stainless steel, vented.
  - j. Port: Full.

2.4 BRONZE SWING CHECK VALVES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. American Valve, Inc.
- 2. Crane Co.; Crane Valve Group; Crane Valves.
- 3. Crane Co.; Crane Valve Group; Jenkins Valves.
- 4. Crane Co.; Crane Valve Group; Stockham Division.
- 5. Hammond Valve.
- 6. Milwaukee Valve Company.
- 7. NIBCO Inc.
- 8. Powell Valves.
- 9. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 200 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

C. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Description:
  - a. Standard: MSS SP-80, Type 3.
  - b. CWP Rating: 300 psig.
  - c. Body Design: Horizontal flow.
  - d. Body Material: ASTM B 62, bronze.
  - e. Ends: Threaded.
  - f. Disc: Bronze.

2.5 BRONZE GLOBE VALVES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crane Co.; Crane Valve Group; Crane Valves.
2. Crane Co.; Crane Valve Group; Stockham Division.
3. Hammond Valve.
4. Milwaukee Valve Company.
5. NIBCO Inc.
6. Powell Valves.
7. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Class 125, Bronze Globe Valves with Bronze Disc:

1. Description:
  - a. Standard: MSS SP-80, Type 1.
  - b. CWP Rating: 200 psig.
  - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
  - d. Ends: Threaded or solder joint.
  - e. Stem and Disc: Bronze.
  - f. Packing: Asbestos free.
  - g. Handwheel: Malleable iron.

- C. Class 125, Bronze Globe Valves with Nonmetallic Disc:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 200 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
    - d. Ends: Threaded or solder joint.
    - e. Stem: Bronze.
    - f. Disc: PTFE or TFE.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron.
  
- D. Class 150, Bronze Globe Valves with Nonmetallic Disc:
  - 1. Description:
    - a. Standard: MSS SP-80, Type 2.
    - b. CWP Rating: 300 psig.
    - c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
    - d. Ends: Threaded.
    - e. Stem: Bronze.
    - f. Disc: PTFE or TFE.
    - g. Packing: Asbestos free.
    - h. Handwheel: Malleable iron.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.
- E. Install chainwheels on operators for valves 6 inches and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.
- F. Install check valves for proper direction of flow and as follows:
  - 1. Swing Check Valves: In horizontal position with hinge pin level.
  - 2. Center-Guided Check Valves: In horizontal or vertical position, between flanges.
  - 3. Lift Check Valves: With stem upright and plumb.

### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball, butterfly, gate, or plug valves.
  - 2. Butterfly Valve Dead-End Service: Single-flange (lug) type.
  - 3. Throttling Service: Globe or angle, ball, or butterfly valves.
- B. Pressure ratings for valves shall not be less than as required by system pressures.
- C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.
- D. Select valves, except wafer types, with the following end connections:
  - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Bronze Angle Valves: Class 125 or Class 150, bronze or nonmetallic disc.
3. Ball Valves: Two piece, full port, bronze with brass, bronze, stainless-steel trim.
4. Bronze Swing Check Valves: Class 125 or Class 150, bronze or nonmetallic disc.
5. Bronze Globe Valves: Class 125 or Class 150, bronze or nonmetallic disc.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Pipe positioning systems.
  - 8. Equipment supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
  - 4. Pipe positioning systems.

- B. Welding certificates.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

### 2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Acceptable Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Carpenter & Paterson, Inc.
  - 3. Empire Industries, Inc.
  - 4. Globe Pipe Hanger Products, Inc.
  - 5. Grinnell Corp.
  - 6. GS Metals Corp.
  - 7. National Pipe Hanger Corporation.
  - 8. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### 2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

### 2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.



B. Acceptable Manufacturers:

1. B-Line Systems, Inc.; a division of Cooper Industries.
2. GS Metals Corp.
3. Power-Strut Div.; Tyco International, Ltd.
4. Thomas & Betts Corporation.
5. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Acceptable Manufacturers:

1. Carpenter & Paterson, Inc.
2. PHS Industries, Inc.
3. Pipe Shields, Inc.
4. Rilco Manufacturing Company, Inc.
5. Value Engineered Products, Inc.
6. Armacell, LLC.

C. Insulation-Insert Material for Cold Piping: Single piece closed cell insulation with 30 mil thick painted aluminum outer shell and self-adhesive closure (Armafix IPH).

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Acceptable Manufacturers:

- a. B-Line Systems, Inc.; a division of Cooper Industries.
- b. Empire Industries, Inc.
- c. Hilti, Inc.

- d. ITW Ramset/Red Head.
- e. MKT Fastening, LLC.
- f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

2.8 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

- 
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20), from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

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- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Joint Stress: Install hangers and supports to provide indicated pipe slopes so maximum pipe deflections and joint stresses allowed by ASME B31.9 (for building services piping) are not exceeded.
- M. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.

- b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
  - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
- a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
4. Shield Dimensions for Pipe: Not less than the following:
- a. NPS 1/4 to NPS 3: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
5. Insert Material: Length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 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 220529



SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Pipe labels.
  - 3. Stencils.
  - 4. Valve tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/2 inch and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.3 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Fiberboard or metal.
  - 2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
  - 3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 EQUIPMENT LABEL INSTALLATION

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

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09 Section "Interior Painting".

- B. Stenciled Pipe Label Option: Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels complying with ASME A13.1, on each piping system.
  - 1. Identification Paint: Use for contrasting background.
  - 2. Stencil Paint: Use for pipe marking.
  
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment and within mechanical rooms, boiler rooms, chiller rooms, etc.
  - 7. On piping above removable acoustical ceilings.
  
- D. Pipe Label Color Schedule:
  - 1. Domestic Water Piping:
    - a. Background Color: Blue.
    - b. Letter Color: White.
  
  - 2. Sanitary Waste and Storm Drainage Piping:
    - a. Background Color: Black.
    - b. Letter Color: White.

### 3.4 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; 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.
  
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches.

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2. Valve-Tag Color:
  - a. Cold Water: Natural.
  - b. Hot Water: Natural.
  
3. Letter Color:
  - a. Cold Water: Black.
  - b. Hot Water: Black.

END OF SECTION 220553

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SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
  - c. Molded Close Cell.
- 2. Fire-rated insulation systems
- 3. Insulating cements.
- 4. Adhesives.
- 5. Mastics.
- 6. Lagging adhesives.
- 7. Sealants.
- 8. Factory-applied jackets.
- 9. Field-applied jackets.
- 10. Tapes.
- 11. Securements.
- 12. Corner angles.

B. Related Sections include the following:

- 1. Division 23 Section "HVAC Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

- 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
- 2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.
5. Detail field application for each equipment type.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.



PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. NOMACO Insulation.
  - 2. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- G. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville.
    - b. Knauf Insulation.
    - c. Manson Insulation Inc.
    - d. Owens Corning Fiberglas Corp.
  - 2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.

- H. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning Fiberglas Corp.
  - 2. Density: 2.5 lbs/cu. ft.
  - 3. Thermal Conductivity: Not exceeding 0.27 BTU-in/hour °F at 75°F mean temperature.
- I. Molded Close Cell Insulation: Soft resilient molded vinyl with internal ribs complying with ASTM G21 and G22 for bacteria/fungus growth.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements provide product by IFS Corporation; Truebro.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LCC.
    - c. Foster Products Corporation, H. B. Fuller Company.
    - d. RBX Corporation.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Products, Division of ITW.
    - b. Foster Products Corporation, H. B. Fuller Company.
    - c. ITW TACC, Division of Illinois Tool Works.
    - d. Marathon Industries, Inc.
    - e. Mon-Eco Industries, Inc.
  - 2. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 FR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Products, Division of ITW.
    - b. Foster Products Corporation, H. B. Fuller Company.
    - c. ITW TACC, Division of Illinois Tool Works.
    - d. Marathon Industries, Inc.
    - e. Mon-Eco Industries, Inc.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Dow Chemical Company (The).
    - b. Johns-Manville; Zeston Perma-Weld.
    - c. P.I.C. Plastics, Inc.
    - d. Speedline Corporation.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
  - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Childers Products, Division of ITW.
  - 2. Foster Products Corporation, H. B. Fuller Company.
  - 3. ITW TACC, Division of Illinois Tool Works.
  - 4. Marathon Industries, Inc.
  - 5. Mon-Eco Industries, Inc.
  
- C. Vapor-Barrier Mastic: Water or solvent based; suitable for indoor and outdoor use on below ambient services.
  - 1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.05 perm at 43-mi dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 4. Color: White.
  
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  - 2. Service Temperature Range: Minus 20 to plus 200 deg F.
  - 3. Solids Content: 63 percent by volume and 73 percent by weight.
  - 4. Color: White.

2.5 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Products, Division of ITW.
    - b. Foster Products Corporation, H. B. Fuller Company.
    - c. Marathon Industries, Inc.
    - d. Mon-Eco Industries, Inc.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
  - 4. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 5. Color: White.

2.6 SEALANTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Childers Products, Division of ITW.
  2. Foster Products Corporation, H. B. Fuller Company.
  3. Marathon Industries, Inc.
  4. Mon-Eco Industries, Inc.
  5. Pittsburgh Corning Corporation.
- B. Joint Sealants for Cellular-Glass:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Permanently flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 100 to plus 300 deg F.
  4. Color: White or gray.
  5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. FSK and Metal Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: Aluminum.
  5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
1. Materials shall be compatible with insulation materials, jackets, and substrates.
  2. Fire- and water-resistant, flexible, elastomeric sealant.
  3. Service Temperature Range: Minus 40 to plus 250 deg F.
  4. Color: White.
  5. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.7 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, Kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with Kraft-paper backing; complying with ASTM C 1136, Type II.

2.8 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. Metal Jacket:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Products, Division of ITW.
    - b. PABCO Metals Corporation.
    - c. RPR Products, Inc.
  - 2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.9 TAPES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Avery Dennison Corporation, Specialty Tapes Division.
  - 2. Compac Corp.
  - 3. Ideal Tape Co., Inc., an American Biltrite Company.
  - 4. Venture Tape.
- B. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Width: 3 inches.
  - 2. Thickness: 11.5 mils.
  - 3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Width: 3 inches.
  2. Thickness: 6.5 mils.
  3. Adhesion: 90 ounces force/inch in width.
  4. Elongation: 2 percent.
  5. Tensile Strength: 40 lbf/inch in width.
  6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

## 2.10 SECUREMENTS

### A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

### B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

### C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  - 2. Verify that surfaces to be insulated are clean and dry.
  - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.



2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- C. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

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7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturers' recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FIRE-RATED INSULATION SYSTEM INSTALLATION

A. Where fire-rated insulation system is indicated, secure system to piping and pipe hangers and supports to maintain a continuous fire rating.

B. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping".

3.10 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- B. Do not field paint aluminum or stainless-steel jackets.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one (1) location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  - 2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three (3) locations of straight pipe, locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. NPS 1/2" through 3/4": Insulation shall be the following:
    - a. Flexible elastomeric: 3/4 inch thick.

2. NPS 1" and larger": Insulation shall be the following:
  - a. Flexible elastomeric: 1 inch thick.
- B. Domestic Hot and Recirculated Hot Water:
  1. NPS 1-1/4" and smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
    - b. Flexible elastomeric: 1 inch thick
  2. NPS 1-1/2" and larger:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inch thick.
    - b. Flexible elastomeric: 1-1/2 inch thick
- C. Stormwater and Overflow:
  1. All Pipe Sizes (vertical and horizontal): Insulation shall be the following:
    - a. Flexible elastomeric: 1 inch thick.
- D. Waste, Vent, Storm Water and Overflow Location in Return Air Plenums:
  1. Unifrax Fire Wrap 0.5 Plenum Insulation or Equal: 1/2 inch thick.
- E. Roof Drain and Overflow Drain Bodies:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 1 inch thick.
- F. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Molded Closed Cell: 1/2 inch thick.
- G. Condensate, Drinking Fountain Waste and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
- H. Floor Drains/Floor Sinks Bodies and Traps Located in Mechanical Rooms with occupied space below, and Sanitary Drain Piping from these drains/sinks, up to main risers:
  1. All Pipe Sizes: Insulation shall be the following:
    - a. Flexible Elastomeric: 3/4 inch thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Concealed:
  - 1. None.
- D. Equipment, Exposed:
  - 1. None.
- E. Piping, Concealed:
  - 1. None.
- F. Piping, exposed in mechanical room piping that is within 6 ft. of the floor.
  - 1. Aluminum, Smooth: 0.016 inch thick.

END OF SECTION 220700



SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
  - 2. Specialty valves.
  - 3. Flexible connectors.
  - 4. Escutcheons.
  - 5. Sleeves.

1.3 SUBMITTALS

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Flexible connectors.
  - 5. Escutcheons.
  - 6. Sleeves.

- B. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
  - 1. Notify Architect no fewer than seven (7) days in advance of proposed interruption of water service.

2. Do not proceed with interruption of water service without Architect's written permission.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
  1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
  2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
  3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
  4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.
- B. Copper Pressure-Seal-Joint Fittings:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Elkhart Products Corporation.
    - b. NIBCO Inc.
    - c. Viega.
  2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O- ring seal in each end.
  3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

### 2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.4 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Calpico, Inc.
  - 2. Capitol Manufacturing Company.
  - 3. Central Plastics Company.
  - 4. EPCO Sales, Inc.
  - 5. Hart Industries International, Inc.
  - 6. Lochinvar Corp.
  - 7. Victaulic
  - 8. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 9. Zurn Plumbing Products Group; Wilkins Water Control Products.
- C. Dielectric Couplings:
  - 1. Description:
    - a. Galvanized-steel coupling.
    - b. Pressure Rating: 300 psig at 225 deg F.
    - c. End Connections: Female threaded.
    - d. Lining: Inert and noncorrosive, thermoplastic.
- D. Dielectric Nipples:
  - 1. Description:
    - a. Electroplated steel nipple complying with ASTM F 1545 (Victaulic Style 47).
    - b. Pressure Rating: 300 psig at 225 deg F.
    - c. End Connections: Male threaded or grooved.
    - d. Lining: Inert and noncorrosive, propylene.

2.5 ESCUTCHEONS

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.
- C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.
- D. One Piece, Stamped Steel: Chrome-plated finish with setscrew.
- E. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.
- F. Split Plate, Stamped Steel: Chrome-plated finish with concealed hinge, setscrew.

- G. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- H. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.6 SLEEVES

- A. Cast-Iron Wall Pipes: Fabricated of cast iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
- B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint or ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.
- C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

2.7 GROUT

- A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- C. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

- E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- H. Install piping adjacent to equipment and specialties to allow service and maintenance.
- I. Install piping to permit valve servicing.
- J. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- N. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

**3.2 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

- G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.3 VALVE INSTALLATION

- A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.4 TRANSITION FITTING INSTALLATION

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
  - 1. NPS 1-1/2 and Smaller: Fitting-type waterways.
  - 2. NPS 2 and Larger: Sleeve-type coupling.
- C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.5 DIELECTRIC FITTING INSTALLATION

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.

3.6 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Support vertical piping and tubing at base and at each floor.
- C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
- D. Install hangers for copper piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
  - 2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
  - 3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
  - 4. NPS 2-1/2: 108 inches with 1/2-inch rod.
  - 5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
- E. Install supports for vertical copper piping every 10 feet. For piping 2" and smaller install guide at midpoint between supports.
- F. Install supports for vertical steel piping every 15 feet.
- G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  - 1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
  - 2. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.8 ESCUTCHEON INSTALLATION

- A. Install escutcheons for penetrations of walls, ceilings, and floors.
- B. Escutcheons for New Piping:
  - 1. Piping with Fitting or Sleeve Protruding from Wall: One piece, deep pattern.
  - 2. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
  - 3. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, cast brass with polished chrome-plated finish.
  - 4. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.
  - 5. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.
  - 6. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.9 SLEEVE INSTALLATION

- A. General Requirements: Install sleeves for pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.
- B. Sleeves are not required for core-drilled holes.
- C. Permanent sleeves are not required for holes formed by removable PE sleeves.
- D. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.
- E. Install sleeves in new partitions, slabs, and walls as they are built.
- F. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- G. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.
- H. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.
- I. Seal space outside of sleeves in concrete slabs and walls with grout.
- J. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.
- K. Install sleeve materials according to the following applications:
  - 1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.
  - 2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.
    - a. Extend sleeves 2 inches above finished floor level.



- b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
- 3. Sleeves for Piping Passing through Gypsum-Board Partitions:
  - a. Galvanized-steel sheet sleeves for pipes smaller than NPS 6.
  - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
  - c. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.
- 4. Sleeves for Piping Passing through Interior Concrete Walls:
  - a. Steel pipe sleeves for pipes smaller than NPS 6.
  - b. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
- L. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.
- B. Label pressure piping with system operating pressure.

3.11 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Piping Inspections:
  - 1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
  - 2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
    - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
    - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
  - 3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
  - 4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.12 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.13 CLEANING

A. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

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2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets. Flush at 10 ft/sec to comply with NFPA standards.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
  - B. Prepare and submit reports of purging and disinfecting activities.
  - C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.14 PIPING SCHEDULE

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Aboveground domestic water piping, NPS 2 and smaller, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought- copper solder-joint fittings; and brazed or soldered joints.
- D. Aboveground domestic water piping, NPS 2-1/2 and larger, shall be one of the following:
  1. Hard copper tube, ASTM B 88, Type L; cast- or wrought-copper solder-joint fittings; and brazed or soldered joints.
  2. Hard copper tube, ASTM B 88, Type L; grooved-joint copper-tube appurtenances; and grooved joints.
  3. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

### 3.15 VALVE SCHEDULE

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  1. Shutoff Duty: Use ball or gate valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

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2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
  3. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
  - 3. Balancing valves.
  - 4. Temperature-actuated water mixing valves.
  - 5. Strainers.
  - 6. Hose bibbs.
  - 7. Drain valves.
  - 8. Water hammer arresters.
  - 9. Air vents.
- B. Related Sections include the following:
  - 1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.
  - 2. Division 22 Section "Domestic Water Piping" for water meters.
  - 3. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 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. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Conbraco Industries, Inc.
  - 2. FEBCO; SPX Valves & Controls.
  - 3. Rain Bird Corporation.
  - 4. Toro Company (The); Irrigation Div.
  - 5. Watts Industries, Inc.; Water Products Div.
  - 6. Woodford Manufacturing Company.
  - 7. Zurn Industries, LLC; Wilkins Div.
- B. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Standard: ASSE 1001.
  - 2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
  - 3. Body: Bronze.
  - 4. Inlet and Outlet Connections: Threaded.
  - 5. Finish: Chrome plated.
- C. Hose-Connection Vacuum Breakers:
  - 1. Standard: ASSE 1011.
  - 2. Body: Bronze, nonremovable, with manual drain.
  - 3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
  - 4. Finish: Chrome or nickel plated.

2.2 BACKFLOW PREVENTERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Conbraco Industries, Inc.

2. FEBCO; SPX Valves & Controls.
3. McDonald, A.Y. Mfg Co.
4. Mueller Co. Water Products Div.
5. Watts Industries, Inc.; Water Products Div.
6. Zurn Industries, LLC; Wilkins Div.

B. Intermediate Atmospheric-Vent Backflow Preventers:

1. Standard: ASSE 1012.
2. Operation: Continuous-pressure applications.
3. Size: NPS ½ or NPS ¾.
4. Body: Bronze.
5. End Connections: Union, solder joint.
6. Finish: Chrome plated.

C. Reduced-Pressure-Principle Backflow Preventers:

1. Standard: ASSE 1013.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
4. Size: To match pipe size.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.
  - b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

D. Double-Check Backflow-Prevention Assemblies:

1. Standard: ASSE 1015.
2. Operation: Continuous-pressure applications, unless otherwise indicated.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Size: To match pipe size.
5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
7. Configuration: Designed for horizontal, straight through flow.
8. Accessories:
  - a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

E. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Operation: Up to 10-foot head of water back pressure.
3. Inlet Size: NPS 1/2 or NPS ¾.

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4. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
5. Capacity: At least 3-gpm flow.

F. Backflow-Preventer Test Kits:

1. Description: Factory calibrated, with gages, fittings, hoses, and carrying case with test-procedure instructions.

## 2.3 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: NPS 1/2 threaded or solder-joint inlet.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Service Areas: Rough bronze.
10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
13. Operation for Finished Rooms: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.4 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.



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## 2.5 WATER HAMMER ARRESTERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AMTROL, Inc.
  - 2. Josam Company.
  - 3. Sioux Chief Manufacturing Company, Inc.
  - 4. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - 5. Tyler Pipe; Wade Div.
  - 6. Watts Drainage Products Inc.
  - 7. Zurn Plumbing Products Group; Specification Drainage Operation.
  
- B. Water Hammer Arresters:
  - 1. Standard: ASSE 1010 or PDI-WH 201.
  - 2. Type: Metal bellows.
  - 3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
  
- B. Install 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.
  - 1. Locate backflow preventers in same room as connected equipment or system.
  - 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
  - 3. Do not install bypass piping around backflow preventers.
  
- C. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
  
- D. Install balancing valves in locations where they can easily be adjusted.
  
- E. Install water hammer arresters in water piping in accessible locations according to PDI-WH 201.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.3 LABELING AND IDENTIFYING

- A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
  - 1. Pressure vacuum breakers.
  - 2. Intermediate atmospheric-vent backflow preventers.
  - 3. Reduced-pressure-principle backflow preventers.
  - 4. Double-check backflow-prevention assemblies.
  - 5. Water pressure-reducing valves.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer and double-check backflow-prevention assembly according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING

- A. Set field-adjustable flow set points of balancing valves.
- B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 221119

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.

1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
  - 2. Sanitary Sewer, Force-Main Piping: 50 psig.

1.4 SUBMITTALS

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

- A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 1785, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 1785, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  - 1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
  - 1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.4 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
  - 1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 3. Unshielded, Nonpressure Transition Couplings:
    - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      - 1) Dallas Specialty & Mfg. Co.
      - 2) Fernco Inc.
      - 3) Mission Rubber Company; a division of MCP Industries, Inc.
      - 4) Plastic Oddities; a division of Diverse Corporate Technologies, Inc.

- b. Standard: ASTM C 1173.
  - c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - d. Sleeve Materials:
    - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
    - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
    - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
- a. Manufacturers: Subject to compliance with requirements available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company; a division of MCP Industries, Inc.
  - b. Standard: ASTM C 1460.
  - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
- C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
  - 1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.

#### 3.2 PIPING INSTALLATION

- A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

- C. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 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. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- D. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent (1/4" slope) downward in direction of flow for piping NPS 3 and smaller; 1 percent (1/8" slope) downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent (1/4" slope) downward in direction of flow.
  - 3. Vent Piping: 1 percent (1/8" slope) down toward vertical fixture vent or toward vent stack.
- E. Install engineered soil and waste drainage and vent piping systems as follows:
  - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
- F. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- G. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.3 JOINT CONSTRUCTION

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
- C. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

### 3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
  - 1. Install transition couplings at joints of piping with small differences in OD's.
  - 2. In Drainage Piping: Shielded, nonpressure transition couplings.

### 3.5 VALVE INSTALLATION

- A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

- B. Backwater Valves: Install backwater valves in piping subject to sewage backflow.
  - 1. Horizontal Piping: Horizontal backwater valves.
  - 2. Floor Drains: Drain outlet backwater valves, unless drain has integral backwater valve.
  - 3. Install backwater valves in accessible locations.
  - 4. Backwater valve are specified in Division 22 Section "Sanitary Waste Piping Specialties."

### 3.6 HANGER AND SUPPORT INSTALLATION

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.
  - 2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - 3. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  - 2. NPS 3: 60 inches with 1/2-inch rod.
  - 3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
  - 1. NPS 1-1/4: 84 inches with 3/8-inch rod.
  - 2. NPS 1-1/2: 108 inches with 3/8-inch rod.
  - 3. NPS 2: 10 feet with 3/8-inch rod.
  - 4. NPS 2-1/2: 11 feet with 1/2-inch rod.
  - 5. NPS 3: 12 feet with 1/2-inch rod.
  - 6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
- H. Install supports for vertical steel piping every 15 feet.

### 3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  - 1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  - 3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  - 4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### 3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  - 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  - 2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  - 3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 60 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  - 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.



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5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

### 3.9 CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 221316

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SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
  - 1. Metal cleanouts.
  - 2. Floor drains.
  - 3. Through-penetration firestop assemblies.
  - 4. Miscellaneous sanitary drainage piping specialties.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities for grease interceptors.
- B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.1 METAL CLEANOUTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - 2. Mifab

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3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.

## B. Exposed Metal Cleanouts:

1. Standard: ASME A112.36.2M for cast iron/ASME A112.3.1 for stainless steel for cleanout test tee.
2. Size: Same as connected drainage piping
3. Body Material: As required to match connected piping.
4. Closure: Raised-head, brass or cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Closure: Stainless-steel plug with seal.

## C. Metal Floor Cleanouts:

1. Standard: ASME A112.36.2M for heavy-duty, adjustable housing cleanout.
2. Size: Same as connected branch.
3. Type: Heavy-duty, adjustable housing.
4. Body or Ferrule: Cast iron.
5. Clamping Device: Required.
6. Outlet Connection: Inside calk/Spigot.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron with threads.
9. Frame and Cover Material and Finish: Polished bronze.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Heavy Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
13. Standard: ASME A112.3.1.
14. Size: Same as connected branch.
15. Housing: Stainless steel.
16. Closure: Stainless steel with seal.
17. Riser: Stainless-steel drainage pipe fitting to cleanout.

## D. Cast-Iron Wall Cleanouts:

1. Standard: ASME A112.36.2M. Include wall access.
2. Size: Same as connected drainage piping.
3. Body: As required to match connected piping.
4. Closure: Raised-head, brass or cast-iron plug.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access: Round, flat, cover plate with screw.

## 2.2 FLOOR DRAINS

### A. Floor Drains:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company.
  - b. Smith, Jay R. Mfg. Co.
  - c. Tyler Pipe; Wade Div.

- d. Watts Industries, Inc.
- e. Zurn Industries, LLC.
  
- 2. Standard: ASME A112.6.3.
- 3. Body Material: Gray iron/Stainless Steel.
- 4. Seepage Flange: Required.
- 5. Clamping Device: Required.
- 6. Outlet: Bottom or Side.
- 7. Backwater Valve: Integral, ASME A112.14.1, swing-check type where specified.
- 8. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
- 9. Sediment Bucket: Where specified.
- 10. Top or Strainer Material: Gray iron/Nickel bronze/Stainless steel.
- 11. Top of Body and Strainer Finish: Gray iron/Nickel bronze/Stainless steel.
- 12. Top Shape: Round.
- 13. Dimensions of Top or Strainer: Minimum 8 inch diameter.
- 14. Top Loading Classification: Extra Heavy-Duty/Heavy Duty/Light Duty/Medium Duty.
- 15. Funnel: Where specified.
- 16. Inlet Fitting: Gray iron, with threaded inlet and threaded or spigot outlet. Trap-seal primer valve connection where shown on drawings.
- 17. Trap Material: PVC.
- 18. Trap Pattern: Standard P-trap.
- 19. Trap Features: ProSet Trap Guard or equal.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

- 1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
- 2. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

- 1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
- 2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  2. Locate at each change in direction of piping greater than 45 degrees.
  3. Locate at minimum intervals of 50 feet.
  4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
  1. Position floor drains for easy access and maintenance.
  2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
    - a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
    - b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
    - c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
  3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
  4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- F. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
- G. Install deep-seal traps on floor drains and other waste outlets, if indicated.

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- H. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- I. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

## 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

## 3.3 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

## 3.4 FLOOR DRAINS SCHEDULE

- A. Floor Drains Schedule:
  - 1. Unfinished Areas on Grade:
    - a. Body Material: Gray iron.
    - b. Top of Body and Strainer Finish: Gray iron.
    - c. Strainer Material: Gray iron.
    - d. Top Loading Classification: Extra heavy duty.
    - e. Integral Tray and Cleanout: Required.
    - f. Backwater Valve: Required.
  - 2. Unfinished Areas above Ground:
    - a. Body Material: Gray iron.
    - b. Top of Body and Strainer Finish: Gray iron.

- c. Top Loading Classification: Extra heavy duty.
  - d. Strainer Material: Gray iron.
  - e. Integral Trap and Cleanout: Required.
3. Finished Areas on Grade.
- a. Body Material: Gray iron.
  - b. Top of Body and Strainer: Nickel bronze.
  - c. Top Loading Classifications: Light duty.
  - d. Integral Trap and Cleanout: Required.
  - e. Backwater Valve: Required.
4. Finished Areas above Grade:
- a. Body Material: Gray iron.
  - b. Top of Body and Strainer Finish: Nickel bronze.
  - c. Top Loading Classification: Light duty.
  - d. Strainer Material: Nickel bronze.
5. Mechanical Rooms on Grade:
- a. Body Material: Gray iron.
  - b. Top of Body and Strainer Finish: Gray iron.
  - c. Top Loading Classification: Extra heavy duty.
  - d. Strainer Material: Gray iron.
  - e. Trap and Cleanout: Required.
  - f. Backwater Valve: Required.
  - g. Sediment Bucket: Aluminum.
  - h. Drain with 9" deep sump.
6. Mechanical Rooms above Grade:
- a. Body Material: Gray iron.
  - b. Top of Body and Strainer Finish: Gray iron.
  - c. Top Loading Classification: Extra heavy duty.
  - d. Strainer Material: Gray iron.
  - e. Sediment Bucket: Aluminum.
  - f. Drain with 9" deep sump.
7. Funnel Floor Drains: Same as floor drains specified above, but with elongated 8x3 funnel.

END OF SECTION 221319



SECTION 224000 - PLUMBING FIXTURES

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 conventional plumbing fixtures and related components:

1. Faucets for lavatories and sinks.
2. Flushometers.
3. Toilet seats.
4. Protective shielding guards.
5. Fixture supports.
6. Water closets.
7. Lavatories.
8. Commercial sinks.

- B. Related Sections include the following:

1. Division 10 Section "Toilet, Bath, and Laundry Accessories."
2. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.
3. Division 22 Section "Drinking Fountains and Water Coolers."

1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.

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- G. PMMA: Polymethyl methacrylate (acrylic) plastic.
- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

## 1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. 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.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
  - 2. Vitreous-China Fixtures: ASME A112.19.2M.

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3. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
4. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Faucets: ASME A112.18.1.
2. Hose-Connection Vacuum Breakers: ASSE 1011.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
5. NSF Potable-Water Materials: NSF 61.
6. Pipe Threads: ASME B1.20.1.
7. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
8. Supply Fittings: ASME A112.18.1.
9. Brass Waste Fittings: ASME A112.18.2.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Brass Waste Fittings: ASME A112.18.2.
4. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.
6. Plastic Toilet Seats: ANSI Z124.5.
7. Supply and Drain Protective Shielding Guards: ICC A117.1.

## 1.6 WARRANTY

1. Warranty Period for Commercial Applications: One (1) year from date of final acceptance by Owner.

## 1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than 2.
2. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

PART 2 - PRODUCTS

2.1 FAUCETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Standard Companies, Inc.
  - 2. Bradley Corporation.
  - 3. Chicago Faucets.
  - 4. Delta Faucet Company.
  - 5. Eljer.
  - 6. Kohler Co.
  - 7. Moen, Inc.
  - 8. Royal Brass Mfg. Co.
  - 9. Speakman Company.
  - 10. T & S Brass and Bronze Works, Inc.
  - 11. Zurn Industries, LLC; Commercial Brass Operation.
  
- B. Description: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture holes; coordinate outlet with spout and fixture receptor.
  - 1. Body Material: Commercial, solid brass.
  - 2. Finish: Polished chrome plate.
  - 3. Maximum Flow Rate: 0.5 gpm unless rated otherwise.

2.2 FLUSHOMETERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Sloan Valve Company.
  - 2. Zurn Industries, LLC; Commercial Brass Operation.
  
- B. Description: Flushometer for urinal or water-closet-type fixture. Include brass body with corrosion-resistant internal components, control stop with check valve, vacuum breaker, sensor operated battery powered copper or brass tubing, and polished chrome-plated finish on exposed parts.

2.3 TOILET SEATS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Standard Companies, Inc.
  - 2. Bemis Manufacturing Company.
  - 3. Church Seats.
  - 4. Eljer.
  - 5. Kohler Co.

6. Olsonite Corp.
7. Sanderson Plumbing Products, Inc.; Beneke Div.
8. Zurn Industries, LLC; Commercial Fixtures.

B. Description: Toilet seat for water-closet-type fixture.

1. Material: Molded, solid plastic with antimicrobial agent.
2. Configuration: Open front with cover.
3. Size: Elongated.
4. Hinge Type: stainless steel, self-sustaining, external check.
5. Color: White, unless noted otherwise.

## 2.4 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
  - b. McGuire Manufacturing Co., Inc.
  - c. TRUEBRO, Inc.
  - d. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. TRUEBRO, Inc.
  - b. Sloan Valve Co.
2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

## 2.5 FIXTURE SUPPORTS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. Smith, Jay R. Mfg. Co.
3. Tyler Pipe; Wade Div.
4. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
5. Zurn Industries, LLC; Specification Drainage Operation.

B. Water-Closet Supports:

1. Description: Combination carrier designed for mounting height of wall-mounting or floor mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space. Support shall be designed to withstand minimum 300 lbs. weight on fixture.

C. Urinal Supports:

1. Description: Type for wall-mounting, urinal-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

D. Lavatory Supports:

1. Description: Type for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
2. Accessible-Fixture Support: Include rectangular steel uprights.

2.6 WATER CLOSETS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Standard Companies, Inc.
2. Kohler Co.

B. Description Wall/Floor-mounting, back/floor-outlet, vitreous-china fixture designed for operation. Minimum 300 lbs. weight capacity. Fixture shall be ADA compatible where specified. Provide with approved neoprene gasket from manufacturer at outlet.

1. Bowl Type: Elongated with siphon-jet design.
2. Design Consumption: Maximum 1.28 gal./flush.
3. Color: White, unless noted otherwise.

2.7 URINALS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Standard Companies, Inc.
2. Kohler Co.

B. Description: Wall-mounting, back-outlet, vitreous-china fixture designed for flushometer valve operation. Fixture shall be ADA compatible where specified. Provide with approved neoprene gasket from manufacturer at outlet.

1. Design Consumption: 0.5 gal./flush unless noted otherwise.
2. Color: White, unless noted otherwise.
3. Fixture Support: Urinal chair carrier.

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## 2.8 LAVATORIES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Standard Companies, Inc.
  - 2. Kohler Co.
- B. Description: Wall or Counter -mounting, vitreous-china fixture.
  - 1. Color: White, unless noted otherwise.

## 2.9 COMMERCIAL SINKS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Standard Co., Inc.
  - 2. Elkay Manufacturing Co.
  - 3. Just Manufacturing Company.
  - 4. Kohler Co.
  - 5. Marlo Manufacturing.
- B. Description: Counter-mounting/Wall mounting, stainless-steel commercial sink fixture.
  - 1. Material: 18 gauge, type 304. Stainless steel with satin finish.
  - 2. Type: Self-rimming for counter mounting, with back-splash for wall mounting.
  - 3. Number of Compartment: As shown on drawings.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
  - 1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  - 2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  - 3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
  - 1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install toilet seats on water closets.
- L. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- M. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- N. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- O. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- P. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- Q. Set shower receptors and janitor's sinks in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."



- R. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers/hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

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### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.
- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

### 3.7 PROTECTION

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230500 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Sleeves.
  - 5. Escutcheons.
  - 6. Grout.
  - 7. Coordination drawings.
  - 8. Project Record Drawings.
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Painting and finishing.
  - 11. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel".

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping".
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Any additional costs as a result of these modifications shall be borne by the contractor. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

**1.7 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Mechanical contractor shall be responsible for furnishing and installing access doors required for their work.
- D. Sequence, coordinate, and integrate installations of HVAC materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning before closing in building.
- E. Coordinate connection of HVAC systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.
- F. Coordinate installation of identifying devices after completing covering and painting, if devices are applied to surfaces. Install identifying devices before installing acoustical ceilings and similar concealment.
- G. Sequence, coordinate, and integrate removal of existing equipment and material as required to maintain services for existing building and for portions of remodeled areas at all times.

**1.8 SCHEDULING AND PHASING**

- A. All HVAC work shall be scheduled to meet project completion date. HVAC work shall be phased for projects requiring phasing of work. Install additional fittings, valves, caps, and dampers as required to support phasing. Refer to phasing schedule on drawings.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

**2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### 2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
  - 1. CPVC Piping: ASTM F 493.
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
- I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

### 2.4 TRANSITION FITTINGS

- A. Acceptable Manufacturers:
  - 1. Eslon Thermoplastics.
  - 2. NIBCO, Inc.
  - 3. Thompson Plastics, Inc.

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- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Acceptable Manufacturers:
  - 1. Capitol Manufacturing Co.
  - 2. Capico Inc.
  - 3. Epco Sales, Inc.
  - 4. Hart Industries, International, Inc.
  - 5. Victaulic
  - 6. Watts Industries, Inc.; Water Products Div.
  - 7. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- G. Dielectric Waterways: Victaulic Series 47 or equal electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

## 2.6 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.7 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
  - 1. Finish: Polished chrome-plated or rough brass.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.8 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.
  - 3. Packaging: Premixed and factory packaged.



**2.9 COORDINATION DRAWINGS**

- A. The contractor shall prepare CAD generated overall coordination drawings (min 1/4" scale) to coordinate HVAC systems installation with other trades. Following systems/items shall be indicated and co-coordinated, but not limited to, with each other based on input from installers of these systems:
  - 1. Ceiling layout.
  - 2. Sheet metal ductwork including locations of boxes, diffusers, grilles/registers, duct risers, fire/smoke dampers, etc.
  - 3. HVAC piping routing including locations of valves, expansion loops, risers, etc.
  - 4. Fire suppression piping mains, sprinkler heads, flow switches, etc.
  - 5. Plumbing piping routing including locations of valves, drops to fixtures, risers, etc.
  - 6. Medical gas piping routing including locations of zone valves, drops to outlets/headwalls, etc.
  - 7. Electrical systems including locations of light fixtures, routing of main feeders/conduits larger than 3" dia., routing of cable tray, etc.
- B. Contractor shall obtain information of other systems from General Contractor, Electrical Contractor, Fire Suppression Contractor, Plumbing Contractor and others as required for incorporation in the coordination drawings.
- C. Contractor shall arrange coordination meeting with other contractors, whose systems need coordination, to resolve conflicts.

**PART 3 - EXECUTION**

**3.1 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas. Mechanical contractor shall be responsible for furnishing and installing access doors required for their work.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping minimum 8 inches above accessible ceilings to allow sufficient space for ceiling panel removal and service access.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
    - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
  - 2. Existing Piping: Use the following:
    - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
    - b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
    - e. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
    - f. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
    - g. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Section 079200 "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- T. Verify final equipment locations for roughing-in.

- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- V. Draining and Refilling of Systems: Provide all shutoff valves, drain valves, pipe, fittings, and miscellaneous material required to drain each existing system as required for new work. After new work is completed, tested, and found tight, refill each system as required. Time for shutting down existing system for draining shall be coordinated with all other work and with Owner's representative. Fill glycol system with type and percentage solutions as directed by Owner.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook", "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
  - 1. Chilled Water: red rubber.
  - 2. Heating Water and Steam: Flexitaulic Flexicarb Style GC or equal.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

- 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
- 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
  
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
  - 1. Plain-End Pipe and Fittings: Use butt fusion.
  - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

### 3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
  - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
  - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
  - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### 3.5 PAINTING

- A. Painting of HVAC systems, equipment, and components is specified in Section 099123 "Interior Painting".

- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

**3.6 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- B. Field Welding: Comply with AWS D1.1.

**3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

**3.8 GROUTING**

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

END OF SECTION 230500

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
  - 1. Motor controllers.
  - 2. Torque, speed, and horsepower requirements of the load.
  - 3. Ratings and characteristics of supply circuit and required control sequence.
  - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated. All motor shall meet minimum ASHRAE energy efficiency requirements.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Motors ½ HP and Larger: Three phase, unless shown otherwise.
- B. Motors Smaller than ½ HP: Single phase, unless shown otherwise.

- C. Frequency Rating: 60 Hz.
- D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
- E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
- F. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
- H. Enclosure: Open drip-proof.

### 2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F unless otherwise noted.
- I. Code Letter Designation:
  - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
  - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

### 2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.



- B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
  - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
  - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
  - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
  - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
  - 5. Motors under 100 hp – Provide Aegis, Helwig Carbon Products or equal shaft grounding on either the drive end or non-drive end of the motor in accordance with manufacturer's recommendations.
  - 6. Motors 100 hp and above – Provide ceramic bearing or bearing journal on non-drive end of the motor and Aegis shaft grounding ring on the opposite end in accordance with manufacturer's recommendations.

## 2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
  - 1. Permanent-split capacitor.
  - 2. Split phase.
  - 3. Capacitor start, inductor run.
  - 4. Capacitor start, capacitor run.
  - 5. Electronically commutated, brushless DC.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller:
  - 1. Shaded-pole type.
  - 2. Electronically commutated, brushless DC.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

**END OF SECTION 230513**

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SECTION 230523 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes general duty valves common to several mechanical piping systems.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. Special purpose valves are specified in Division 23 piping system Sections.
  - 2. Valve tags and charts are specified in Division 23 Section "Mechanical Identification."

1.3 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data for each valve type. Include body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions. Include list indicating valve and its application.
- C. Maintenance data for valves to include in the operation and maintenance manual specified in Division 1. Include detailed manufacturer's instructions on adjusting, servicing, disassembling, and repairing.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Comply with the requirements specified in Division 1 Section "Materials and Equipment," under "Source Limitations" Paragraph.
- B. ASME Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. MSS Compliance: Comply with the various MSS Standard Practice documents referenced.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set globe and gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store indoors and maintain valve temperature higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use a sling to handle large valves. Rig to avoid damage to exposed parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Butterfly Valves:

- a. Bray.
- b. Crane Company; Valves and Fitting Division.
- c. Grinnell Corp.
- d. Milwaukee Valve Company, Inc.
- e. NIBCO Inc.
- f. Stockham Valves & Fittings, Inc.

2. Swing Check Valves:

- a. Crane Company; Valves and Fitting Division.
- b. Milwaukee Valve Company, Inc.
- c. NIBCO Inc.
- d. Stockham Valves & Fittings, Inc.

3. Globe Valves:

- a. Crane Company; Valves and Fitting Division.
- b. Milwaukee Valve Company, Inc.
- c. NIBCO Inc.
- d. Stockham Valves & Fittings, Inc.

2.2 BASIC, COMMON FEATURES

- A. Pressure and Temperature Ratings: As indicated in the "Application Schedule" of Part 3 of this Section and as required to suit system pressures and temperatures.
- B. Sizes: Same size as upstream pipe, unless otherwise indicated.
- C. Operators: Use specified operators and handwheels, except provide the following special operator features:
  - 1. Handwheels: For valves other than quarter turn.
  - 2. Lever Handles: For quarter-turn valves 6 inches (DN150) and smaller, except for plug valves, which shall have square heads. Furnish Owner with 1 wrench for every 10 plug valves.
  - 3. Chain-Wheel Operators: For valves 4 inches (DN100) and larger, installed 96 inches (2400 mm) or higher above finished floor elevation.
  - 4. Gear-Drive Operators: For quarter-turn valves 8 inches (DN200) and larger.
- D. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- E. Bypass and Drain Connections: Comply with MSS SP-45 bypass and drain connections.
- F. Threads: ASME B1.20.1.
- G. Flanges: ASME B16.1 for cast iron, ASME B16.5 for steel, and ASME B16.24 for bronze valves.
- H. Solder Joint: ASME B16.18.
  - 1. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F (450 deg C) for gate, globe, and check valves; below 421 deg F (216 deg C) for ball valves.

2.3 BALL VALVES

- A. Chilled Water and Hot Water - Ball Valves: MSS SP-110, 150 lb., 2" and smaller, ASTM B 584 bronze body and bonnet, 2-piece construction; stainless steel ball, full port blowout proof; stainless steel stem; Teflon seats and seals; soldered end connections, NIBCO T-595-Y, NIBCO S-595-Y or equal:
  - 1. Operator: Vinyl-covered steel lever handle.
  - 2. Stem Extension: 1-1/4" long for valves installed in insulated piping.
  - 3. Memory Stop: For operator handles.

2.4 GLOBE VALVES

- A. Chilled Water and Hot Water - Globe Valves, 3 Inches (DN65) and Smaller: MSS SP-80; Class 125, 200-psi (1380-kPa) CWP, or Class 150, 300-psi (2070-kPa) CWP; ASTM B 62 cast-bronze body and screwed bonnet, rubber, bronze, or Teflon disc, silicon bronze-alloy stem, Teflon-impregnated packing with bronze nut, threaded or soldered end connections; and with aluminum or malleable-iron handwheel.

2.5 BUTTERFLY VALVES

- A. Chilled Water and Hot Water - Butterfly Valves: MSS SP-67, 200-psi (1380-kPa) CWP, 150 psi maximum pressure differential, ASTM A 126 cast-iron full lug body and bonnet, extended neck, 316 stainless-steel stem, field-replaceable EPDM sleeve and stem seals, Grinnell Series 8000 or equal:
  - 1. Disc Type: 316 stainless steel.
  - 2. Operator for Sizes 2 Inches (DN50) to 5 Inches (DN150): Lever handle with latch lock with memory.
  - 3. Operator for Sizes 6 Inches (DN200) to 24 Inches (DN600): Gear operator with position indicator with chain 6'-0" A.F.F.
  - 4. Operator for Sizes 6 Inches (DN200) and Larger, 96 Inches (2400 mm) or Higher above Floor: Chain-wheel operator with chain 6'-0" A.F.F.

2.6 CHECK VALVES

- A. Swing Check Valves, 2 Inches (DN65) and Smaller: 150 lb.; horizontal swing, Y-pattern, ASTM B 62 cast-bronze body and cap, soldered connections, NIBCO T-433 or equal:
- B. Swing Check Valves, 2-1/2 Inches (DN80) and Larger: MSS SP-71, Class 125, 200-psi (1380-kPa) CWP, ASTM A 126 cast-iron body and bolted cap, horizontal-swing bronze disc, flanged end connections, NIBCO F-918 or equal.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance of valves. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves from fully open to fully closed positions. Examine guides and seats made accessible by such operation.
- D. Examine threads on valve and mating pipe for form and cleanliness.

- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Check gasket material for proper size, material composition suitable for service, and freedom from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

### 3.2 INSTALLATION

- A. Install valves as indicated, according to manufacturer's written instructions.
- B. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties.
- C. Install valves with unions or flanges at each piece of equipment arranged to allow servicing, maintenance, and equipment removal without system shutdown.
- D. Locate valves for easy access and provide separate support where necessary.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. For chain-wheel operators, extend chains to 60 inches (1500 mm) above finished floor elevation.
- H. Installation of Check Valves: Install for proper direction of flow as follows:
  - 1. Swing Check Valves: Horizontal position with hinge pin level.
  - 2. Lift Check Valve: With stem upright and plumb.

### 3.3 SOLDERED CONNECTIONS

- A. Cut tube square and to exact lengths.
- B. Clean end of tube to depth of valve socket with steel wool, sand cloth, or a steel wire brush to a bright finish. Clean valve socket.
- C. Apply proper soldering flux in an even coat to inside of valve socket and outside of tube.
- D. Open gate and globe valves to fully open position.
- E. Remove the cap and disc holder of swing check valves having composition discs.
- F. Insert tube into valve socket, making sure the end rests against the shoulder inside valve. Rotate tube or valve slightly to ensure even distribution of the flux.
- G. Apply heat evenly to outside of valve around joint until solder melts on contact. Feed solder until it completely fills the joint around tube. Avoid hot spots or overheating valve. Once the solder starts cooling, remove excess amounts around the joint with a cloth or brush.

**3.4 THREADED CONNECTIONS**

- A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.
- B. Align threads at point of assembly.
- C. Apply appropriate tape or thread compound to the external pipe threads, except where dry seal threading is specified.
- D. Assemble joint, wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

**3.5 FLANGED CONNECTIONS**

- A. Align flange surfaces parallel.
- B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- C. For dead-end service, butterfly valves require flanges both upstream and downstream for proper shutoff and retention.

**3.6 VALVE END SELECTION**

- A. Select valves with the following ends or types of pipe/tube connections:
  - 1. Copper Tube Size, 2-1/2 Inches (DN65) and Smaller: Threaded ends.
  - 2. Steel Pipe Sizes, 2-1/2 Inches (DN65) and Smaller: Threaded.
  - 3. Steel Pipe Sizes, 3 Inches (DN80) and Larger: Flanged.

**3.7 APPLICATION SCHEDULE**

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; lubricated plug cocks, and balancing valves for throttling duty, and butterfly valves on pump discharge. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Heating and Chilled Water Systems: Use the following valve types:
  - 1. Ball Valves (up to and including 2"): Two-piece, full port, bronze with stainless-steel trim.
  - 2. Butterfly Valves 3" and Larger: Iron, 200 CWP, EPDM seat, 316 stainless steel disc.
  - 3. Bronze Swing Check: Class 150, with composition seat.
  - 4. Globe Valves: Class 125, 200 psi, cast bronze (ahead of pressure gauges).
  - 5. Balancing Valves: Bell and Gossett Flo-Setter  $\Delta P$  type or Armstrong CBV.



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**ISSUED FOR CONSTRUCTION**

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3.8 ADJUSTING

- A. Adjust or replace packing after piping systems have been tested and put into service, but before final adjusting and balancing. Replace valves if leak persists.

END OF SECTION 230523

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SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following hangers and supports for HVAC system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
- B. Welding certificates with picture ID.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.3, "Structural Welding Code--Sheet Steel."
  - 4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Acceptable Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Carpenter & Paterson, Inc.
  - 3. Empire Industries, Inc.
  - 4. Globe Pipe Hanger Products, Inc.
  - 5. Grinnell Corp.
  - 6. GS Metals Corp.
  - 7. National Pipe Hanger Corporation.
  - 8. Piping Technology & Products, Inc.
- C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Acceptable Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. GS Metals Corp.
  - 3. Power-Strut Div.; Tyco International, Ltd.
  - 4. Thomas & Betts Corporation.
  - 5. Unistrut Corp.; Tyco International, Ltd.
- C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

- A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.
- B. Acceptable Manufacturers:
  - 1. Carpenter & Paterson, Inc.
  - 2. PHS Industries, Inc.
  - 3. Pipe Shields, Inc.
  - 4. Rilco Manufacturing Company, Inc.
  - 5. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

- G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

- A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
  - 1. Acceptable Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.

2.7 PIPE STAND FABRICATION

- A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
  - 1. Acceptable Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
- C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.
- D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
  - 1. Base: Plastic or Stainless steel.
  - 2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  - 3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
  - 1. Bases: One or more plastic.
  - 2. Vertical Members: Two or more protective-coated-steel channels.
  - 3. Horizontal Member: Protective-coated-steel channel.
  - 4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes and then hot dipped or cold galvanized.

2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.

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7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.



- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.

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5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
  - M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
  - N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- F. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes and then hot dipped or cold galvanize.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.
- N. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Heating Water, Steam, Steam Condensate and Pumped Condensate Piping: Clamp may project through insulation.
    - b. Chilled Water and Condensate Drain Piping: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.4 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### 3.5 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

**3.6 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Cold galvanize 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair stick to comply with ASTM A 780.

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SECTION 230553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Duct labels.
  - 4. Stencils.
  - 5. Warning tags.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
3. Minimum Letter Size: 1/2 inch and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel self-tapping screws.
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Letter Color: White.
3. Background Color: Black.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/2 inch and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel self-tapping screws.
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.



- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

### 2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Black.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/2 inch and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

### 2.4 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material: Fiberboard or metal.

2. Stencil Paint: Exterior, gloss, alkyd enamel black unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, alkyd enamel in colors according to ASME A13.1 unless otherwise indicated.

## 2.5 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size: 3 by 5-1/4 inches.
  2. Fasteners: Reinforced grommet and wire or string.
  3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
  4. Color: Yellow background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

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

### 3.2 EQUIPMENT LABEL INSTALLATION

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

### 3.3 DUCT LABEL INSTALLATION

- A. Install plastic-laminated or self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
  1. Blue: For cold-air supply ducts.
  2. Yellow: For hot-air supply ducts.
  3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Stenciled Duct Label Option: Stenciled labels, showing service and flow direction, may be provided instead of plastic-laminated duct labels, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

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- C. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system. Reduce intervals to 25 feet in areas of congested piping and equipment, within mechanical rooms, etc.

### 3.4 WARNING-TAG INSTALLATION

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

END OF SECTION 230553

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SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 DESCRIPTION OF WORK

- A. This scope of services specified the requirements and procedures for mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner's personnel. It is the Contractor's responsibility to assist as outlined below.

- B. Test, adjust and balance the following mechanical systems which are shown in the construction documents.

- 1. Supply air systems.
- 2. Exhaust air systems.
- 3. Verify temperature control system operation.

- C. The contractor's responsibilities are as follows:

- 1. Notify the Owner's Representative fourteen (14) days prior to the schedule date for balancing the system.
- 2. Schedule a two (2) week allowance for the testing and balancing firm to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.
- 3. Cooperate with the testing and balancing firm and shall make all necessary preparations for the TAB efforts.
- 4. Complete the following work prior to requesting the TAB effort.
  - a. Clean and flush all piping systems.
  - b. Leak test and make tight all piping systems.
  - c. Fill all piping systems with clean water.
  - d. Clean and seal all ductwork systems.
  - e. Service and tag all equipment.
  - f. Set and align all motors and drives.
  - g. Start up and prove all equipment and systems.
  - h. Make preliminary settings on all control devices and have all systems operational.
  - i. Operate all systems successfully for twenty-four (24) hours minimum.
- 5. Lubricate all motors and bearings.
- 6. Check fan belt tension.
- 7. Check fan rotation.

8. Patch insulation, ductwork and housing, using materials identical to those removed.
9. Seal ducts and piping, and test for and repair leaks.
10. Seal insulation to re-establish integrity of the vapor barrier.
11. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.
12. Provide a complete set of as-built drawings prior to the TAB effort.
13. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.
14. Change out fan sheaves when and if required by the TAB firm.
15. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.
16. If a significant rebalance (Owner's determination) of the HVAC system is required due to the Contractor's failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

1.3 PRE-BALANCING CONFERENCE

- A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner's Representative, Engineer and the Test and Balance Agency's representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

1.4 SEQUENCING AND SCHEDULING OF SERVICES

- A. Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.

PART 2 - PRODUCTS (Not applicable)

PART 3 - EXECUTION (Not applicable)

END OF SECTION 230593

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Insulation Materials:
  - a. Flexible elastomeric.
  - b. Mineral fiber.
- 2. Insulating cements.
- 3. Adhesives.
- 4. Mastics.
- 5. Lagging adhesives.
- 6. Sealants.
- 7. Factory-applied jackets.
- 8. Field-applied fabric-reinforcing mesh.
- 9. Field-applied cloths.
- 10. Field-applied jackets.
- 11. Tapes.
- 12. Securements.
- 13. Corner angles.

B. Related Sections:

- 1. Division 22 Section "Plumbing Insulation."

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

- 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

- A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.



- F. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. NOMACO Insulation.
  - 2. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour °F at 75°F mean temperature.
- G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning Fiberglas Corp.
  - 2. Density: 1.9 lbs/cu. ft.
  - 3. Thermal Conductivity: Not exceeding 0.25 BTU-in/hour sq. ft. °F at 75°F mean temperature.
- H. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type V, without factory-applied jacket.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning Fiberglas Corp.
  - 2. Density: 3.0 lbs/cu. ft.
  - 3. Thermal Conductivity: Not exceeding 0.30 BTU-in/hour sq. ft. °F at 100°F mean temperature.

- I. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied ASJ. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corp.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Manson Insulation Inc.
    - e. Owens Corning Fiberglas Corp.
  - 2. Density: 3.0 lbs/cu. ft.
  - 3. Thermal Conductivity: Not exceeding 0.23 BTU-in/hour sq. ft. °F at 75°F mean temperature.
  
- J. High-Temperature, Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type III, without factory-applied jacket.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville.
    - b. Owens Corning Fiberglas Corp.
    - c. Rock Wool Manufacturing Company.
  - 2. Density: 3.0 lbs/cu. ft.
  - 3. Thermal Conductivity: Not exceeding 0.30 BTU-in/hour sq. ft. °F at 100°F mean temperature.

2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.

- b. Armacell LCC.
    - c. Foster Products Corporation, H. B. Fuller Company.
    - d. RBX Corporation.
  - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
    - 1. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - D. ASJ Adhesive, and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
    - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Childers Products, Division of ITW.
      - b. Foster Products Corporation, H. B. Fuller Company.
      - c. ITW TACC, Division of Illinois Tool Works.
      - d. Marathon Industries, Inc.
      - e. Mon-Eco Industries, Inc.
    - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - E. PVC Jacket Adhesive: Compatible with PVC jacket.
    - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - a. Dow Chemical Company (The).
      - b. Johns-Manville.
      - c. P.I.C. Plastics, Inc.
      - d. Speedline Corporation
    - 2. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 2.4 FACTORY-APPLIED JACKETS
- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
    - 1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
    - 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
    - 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.5 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Johns Manville.
    - b. P.I.C. Plastics, Inc.
    - c. Proto PVC Corporation.
    - d. Speedline Corporation.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- D. Metal Jacket:
  1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Childers Products, Division of ITW.
    - b. PABCO Metals Corporation.
    - c. RPR Products, Inc.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 1-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.

e. Factory-Fabricated Fitting Covers:

- 1) Same material, finish, and thickness as jacket.
- 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.6 TAPES

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Avery Dennison Corporation, Specialty Tapes Division.
2. Compac Corp.
3. Ideal Tape Co., Inc., an American Biltrite Company.
4. Venture Tape.

B. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

C. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.
3. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
3. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel or aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Surface Preparation: Clean and prepare surfaces to be insulated.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.
- L. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- O. For above ambient services, do not install insulation to the following:
  1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  4. Manholes.
  5. Handholes.
  6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
  1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistive joint sealers.
- D. Insulation Installation at Floor Penetrations:
  1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
  2. Pipe: Install insulation continuously through floor penetrations.
  3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."



**3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION**

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
    - a. Do not weld anchor pins to ASME-labeled pressure vessels.
    - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
    - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.
    - d. Do not overcompress insulation during installation.
    - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
    - f. Impale insulation over anchor pins and attach speed washers.
    - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.

C. Insulation Installation on Pumps:

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.
3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.6 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

### 3.7 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### 3.8 MINERAL-FIBER INSULATION INSTALLATION

- A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Impale insulation over pins and attach speed washers.
    - f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
  5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
  6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    - c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
    - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
  - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  - b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
  1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
  2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
  1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
  1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.10 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- B. Insulate duct access panels and doors to achieve same fire rating as duct.
- C. Install firestopping at penetrations through fire-rated assemblies. Fire-stop systems are specified in Division 07 Section "Penetration Firestopping."

3.11 FINISHES

- A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.12 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system defined in the "Duct Insulation Schedule, General" Article.
  - 2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
- C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.13 DUCT INSULATION SCHEDULE, GENERAL

- A. Plenums and Ducts Requiring Insulation:
  - 1. Indoor, concealed supply and outdoor air.
  - 2. Indoor, exposed supply and outdoor air.
  - 3. Indoor, concealed return and relief air located in non-conditioned space.
  - 4. Indoor, exposed return and relief air located in non-conditioned space, mechanical room.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.14 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, rectangular, round and flat-oval, supply-air, outdoor-air, return air and relief-air duct insulation shall be one of the following:

1. Mineral-Fiber Blanket: 1-1/2 inches thick.
2. Mineral-Fiber Board: 1-1/2 inches thick.

B. Exposed rectangular, round and flat-oval, supply-air, outdoor-air, return-air and relief-air duct insulation shall be the following:

1. Mineral-Fiber Board: 1-½ inches thick.

C. Exposed in Mechanical Rooms, supply-air, return-air, outdoor-air and relief-air plenum insulation shall be the following:

1. Mineral-Fiber Board: 2 inches thick.

END OF SECTION 230700

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SECTION 230900 – CONTROL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. University of Missouri Controls Specification.
- B. This section contains requirements for pneumatic, electric and digital control systems as indicated on the contract drawings.
- C. Contractor is responsible for providing, installing and connecting all sensors, pneumatic actuators, control valves, control dampers, electrical components and all interconnecting pneumatic tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).
- D. DDC systems consist of Johnson Controls METASYS controllers. Contractor shall install owner provided control enclosures. Owner will provide and install controllers. After all equipment has been installed, wired and piped, Owner will be responsible for all termination connections at the DDC controller's and for checking, testing, programming and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.
- E. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.2 RELATED SECTIONS

- A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.3 QUALITY ASSURANCE

- A. Contractor's Qualifications:
  - 1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years' experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Condition's section 3.4.1 and 3.4.4.
- B. Codes and Standards:
  - 1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.

2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.
4. NFPA Compliance: Comply with NFPA 70 "National Electric Code".

**1.4 SUBMITTALS**

- A. Shop Drawings: Submit shop drawings for each control system, containing the following information:
  - B. Product data for each damper, valve, and control device.
  - C. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.
  - D. Label each control device with setting or adjustable range of control.
  - E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.
  - F. Provide details of faces on control panels, including controls, instruments, and labeling.
  - G. Include written description of sequence of operation.
  - H. Provide wiring diagrams of contractor provided interface and I/O panels.
  - I. Provide field routing of proposed network bus diagram listing all devices on bus.

**PART 2 - PRODUCTS**

**2.1 MATERIALS AND EQUIPMENT**

- A. Air Piping:
  1. Copper Tubing: Seamless copper tubing, Type M or L, ASTM B 88; wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment.
  2. Flex Tubing: Virgin Polyethylene non-metallic tubing, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on polyethylene fittings. Tubing used above suspended ceilings to be plenum rated per NFPA 90A. See section 3.1.b for locations where flex tubing can be used.
  3. Copper to polyethylene connections shall be compression barbed fittings or solder barbed fittings.
- B. Conduit and Raceway:
  1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.

2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.
  3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.
  4. Liquidtight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.
- C. Control Valves: Provide factory fabricated pneumatic or electric control valves of type, body material, and pressure class as indicated on the drawings. Butterfly style control valves are not acceptable except for two position applications. Equip control valves with heavy-duty actuators, with proper shutoff rating for each individual application.
1. Steam and Hot Water:
    - a. Manufacturer: Do not allow KMC valves and actuators.
    - b. Water Service Valves: Equal percentage characteristics.
    - c. Steam Service Valves: Equal percentage characteristics.
    - d. Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
    - e. Valve Trim and Stems: Polished stainless steel.
    - f. Packing: Spring-loaded Teflon, self-adjusting.
    - g. Control valves should have a minimum 100 psi close-off rating for chilled water applications.
  2. Hydronic Chilled Water and Heating Water:
    - a. At minimum, hydronic control valves shall be pressure independent. High performing energy monitoring control valves may be considered depending on the project. The flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations across the valve in the selected operating range. The control valve shall accurately control the flow from 1 to 100% full rated flow.
    - b. The valve bodies shall be of cast iron, steel or bronze and rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass, or bronze.
    - c. DeltaP Valves manufactured by Flow Control Industries, Belimo, Danfoss Series, or approved equal.
    - d. The valves shall have pressure taps across the valve for measuring the pressure drop across the valve. The pressure taps shall have ½-inch extensions for accessibility.
    - e. Control valves shall be installed with unions or flanges as necessary for easy removal and replacement.
    - f. Valve Tag shall include the model number, AHU being served, design flow, and maximum flow for that valve.
    - g. The control valves shall be delivered preset to the scheduled design flow and should be capable of reaching 110% of the design flow to allow for field adjustment for capacity changes.
- D. Control Dampers: Ruskin CD-50 or approved equal.
1. Provide dampers with parallel blades for 2- position control.
  2. Provide opposed blades for modulating control.
  3. Dampers shall be low leakage design with blade and edge seals.
  4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.

- E. Electric Actuators: Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable. For VAV reheat valves, actuators shall have a manual override capability to aid in system flushing, startup, and balancing.
  
- F. Air and Hot Water Electronic Temperature Sensors:
  - 1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
  - 2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner's Representative.
  - 3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.
  
- G. Electronic Temperature Sensors and Transmitters:
  - 1. Chilled Water, Tower Water, Heating Hot Water, and Steam Temperature Sensors:
    - a. General: The RTD/Temperature Transmitter/Thermowell assembly shall come as a complete assembly from a single manufacturer. The Assembly shall be suitable for use in the accurate measurement of Chilled/Tower/Hot Water and steam temperatures in a mechanical room environment.
    - b. Calibration: Each RTD must be match calibrated to the Transmitter via NIST traceable calibration standards. Results are to be programmed into the transmitter. Results are to be presented on report as after condition at the specified calibration points. Assembly shall not be approved for installation until Owner has received all factory calibration reports.
    - c. RTD:
      - 1) RTD type: 2-wire or 3-wire 100 ohm platinum class A
      - 2) Outside Diameter: 0.25 inch
      - 3) Tolerance: +/- 0.06% Type A
      - 4) Stability: +/- 0.1 % over one year.
      - 5) TCR: 0.00385 (ohm/ohm/°C).
      - 6) RTD shall be tip sensitive.
      - 7) Resistance vs. Temperature table for the RTD must be provided to the Owner.
    - d. Transmitter:
      - 1) Transmitter shall be match calibrated to the RTD and assembled as a matched pair.
      - 2) Type: 2 wire (loop powered)
      - 3) Input: 2 or 3 wire 100 ohm platinum class A or class B RTD
      - 4) Output: Output shall be a 4-20 mA signal linear to temperature

- 5) Calibrated Span:
  - a) Chilled Water: 30 °F to 130 °F.
  - b) Tower Water: 30 °F to 130 °F.
  - c) Hot Water: 100 °F to 250 °F.
  - d) Steam: 150 °F to 450 °F
- 6) Calibration Accuracy, including total of all errors, of the Transmitter & RTD matched pair over the entire span shall be within +/- 0.2% of the calibrated span or +/- 0.18 °F, whichever is greater.
- 7) Supply Voltage: 24 VDC.
- 8) Ambient Operating Temp.: 32 to 122 °F
- 9) Epoxy potted for moisture resistance.
- 10) Mounting: Transmitter shall be mounted in the RTD connection head.

e. Thermowell

- 1) Thermowell shall be suitable for immersion in chilled/hot water and steam.
- 2) Thermowell shall be reduced tip.
- 3) Thermowell shall be one piece stainless steel machined from solid bar stock.
- 4) Thermowell shall have 1/2" NPT process connection to pipe thread-o-let.
- 5) Thermowell Insertion depth shall be 1/2 the inside pipe diameter but not to exceed 10".

f. Assembly:

- 1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.
- 2) Connection head shall be cast aluminum with chain connecting cap to body, have 1/2" NPT process and 3/4" NPT conduit connections, and a sealing gasket between cap and body.

g. RTD/Temperature Transmitter/Thermowell assembly shall be the following or approved equal:

- 1) Manufacturer: Pyromation, Inc.
- 2) Chilled Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(30-130)F with calibration SMC(40,60)F
- 3) Tower Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(5130)F with calibration SMC(55,85)F
- 4) Hot Water: RAF185L-S4C[length code]08T2-SL-8HN31,TT440-385U-S(100-250)F with calibration SMC(140,180)F
- 5) Steam: RAT185H-S4C[length code]08T2-SL-8HN31,TT440-385U-S(150-450)F with calibration SMC(300,350)F

H. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.

- I. Low Limit Controllers: Provide unit-mounted low limit controllers, of rod-and-tube type, with an adjustable set point and a manual reset. Capillary shall be of adequate length to horizontally traverse face of cooling coil every 12". Multiple low limit controllers may be required for large coils. Controller shall have an extra set of contactors for connection to control panel for alarm status. Locate the thermostat case and bellows where the ambient temperature is always warmer than the set point.
  - 1. Freeze Stats: Johnson Controls model A70HA-1 or approved equal.
- J. Humidistats: Humidistats must be contamination resistant, capable of  $\pm 2\%$  RH accuracy, have field adjustable calibration and provide a linear proportional signal.
  - 1. HD20K-T91 or equivalent.
- K. Humidity High Limit
  - 1. Multi-function device that can function as a high limit or proportional override humidity controller, as stand-alone proportional controller, or a stand-alone two-position controller.
    - a. Johnson Controls TRUERH HL-67N5-8N00P or approved equal.
- L. Carbon Dioxide Sensor:
  - 1. Wall Mount: ACI Model ESENSE-R.
  - 2. Duct Mount: ACI Model ESENSE-D.
- M. Fan/Pump Status: Status points for fan or pump motors with a VFD must be connected to the terminal strip of the VFD for status indication. Current switches: Current switches are required for fan and pump statuses that are not connected to a VFD. The switches must have an adjustable trip setpoint with LED indication and be capable of detecting broken belts or couplings. Units shall be powered by monitored line, UL listed and CE certified, and have a five year warranty.
  - 1. Kele, Hawkeye or approved equal.
- N. Relays Used for Fan and Pump Start/Stop: Must have LED indication and be mounted externally of starter enclosure or VFD.
  - 1. Kele, RIBU1C or approved equal.
- O. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
  - 1. Kele, DCPA-1.2 or approved equal.
- P. Pressure Differential Switch:
  - 1. Fans: NECC model DP222 or approved equal.

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- Q. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
1. Water: Units shall be wet/wet differential pressure capable of a bi-directional pressure range of +/- 50 psid. Accuracy shall be +/- 0.25% full scale with a compensated temperature range of 30 to 150 deg F and a maximum working pressure of 250 psig.
  2. Install transmitter in a pre-manufactured assembly with shut off valves, vent valves and a bypass valve.
    - a. Setra model 230 with Kele model 3-VLV, three valve manifold or approved equal.
  3. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig.
    - a. Setra model 267, or approved equal.
    - b. Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owner's representative.
- R. Building Static Pressure: Transducer shall utilize a ceramic capacitive sensing element to provide a stable linear output over the specified range of building static pressure. Transducer shall be housed in a wall-mounted enclosure with LCD display. Transducer shall have the following capabilities:
1. Input Power: 24 VAC
  2. Output: 0-10 VDC
  3. Pressure Range: -0.25 to +0.25 inches w.g.
  4. Display: 3-1/2 digit LCD, displaying pressure in inches w.g.
  5. Accuracy: +/- 1.0% combined linearity and hysteresis
  6. Temperature Effect: 0.05% / deg C
  7. Zero drift (1 year): 2.0% max
  8. Zero Adjust: Push-button auto-zero and digital input
  9. Operating Environment: 0 to 140 deg F, 90% RH (non-condensing)
  10. Fittings: Brass barbs, 1/8" O.D.
  11. Enclosure: High-impact ABS plastic.
  12. Outside Air Sensor Pickup Port: UV stabilized thermoplastic or aluminum "can" enclosure to shield outdoor pressure sensing tube from wind effects. BAPI ZPS-ACC10-rooftop mount, wall mount, or equivalent.
  13. Transducer shall be Veris Industries Model PXPLX01S, equivalent from Setra, or approved equal.
- S. High Static Pressure Limit Switch: Provide pressure high limit switch to open contact in fan circuit to shut down the supply fan when the inlet static pressure rises above the set point. Provide with an adjustable set point, a manual reset button, 2 SPST (normally closed) contacts, and 1/4" compression fittings.
1. Kele model AFS-460-DDS, or approved equal.
- T. Airflow/Temperature Measurement Devices
1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.

2. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings calculated for each sensor housing shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.
3. All Sensor Probe Assemblies:
  - a. Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
  - b. Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use “chip” or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
  - c. Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/-2% of reading over the entire operating airflow range. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
    - 1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
  - d. The operating temperature range for the sensor probe assembly shall be -20° F to 160 F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
  - e. Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/-0.15°F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
  - f. Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
  - g. Each sensor assembly shall not require matching to the transmitter in the field.
  - h. A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.
4. Duct and Plenum Sensor Probe Assemblies:
  - a. Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly. Thermistor probes shall be mounted in sensor housings using a waterproof marine grade epoxy resin. All wires within the aluminum tube shall be Kynar coated.
  - b. The number of sensor housings provided for each location shall be as follows:
    - 1) 

Area (sq. ft.)	Sensors
<2	4
2 to <4	6
4 to <8	8
8 to <16	12
>=16	16



- c. Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
    - 1) Insertion mounted through the side or top of the duct.
    - 2) Internally mounted inside the duct or plenum.
    - 3) Standoff mounted inside the plenum.
  - d. The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.
5. Fan Inlet Sensor Probe Assemblies:
- a. Sensor housings shall be mounted on 304 stainless steel blocks.
  - b. Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
  - c. Mounting feet shall be constructed of 304 stainless steel.
  - d. The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.
6. Transmitters:
- a. The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
  - b. The transmitter shall be capable of independently monitoring and averaging up to 16 individual airflow and temperature readings. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.
  - c. The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.
  - d. All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
  - e. The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
  - f. The transmitter shall be capable of communicating with the host controls using one of the following interface options:
    - 1) Linear Analog Output Signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
    - 2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus.
    - 3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP.
    - 4) LonWorks Free Topology.
7. The measuring device shall be UL listed as an entire assembly.
8. The manufacturer's authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer's placement requirements.

- 9. Manufacturer:
  - a. Primary flow elements, sensors, meters and transducers shall be EBTRON, Inc. Model GTx116-P and GTx116-F or approved equal.
  - b. The naming of any manufacturer does not automatically constitute acceptance of this standard product nor waive their responsibility to comply totally with all requirements of the proceeding specification.
  
- U. Electrical Requirements: Provide electric-pneumatic switches, electrical devices, and relays that are UL-listed and of type which meet current and voltage characteristics of the project. All devices shall be of industrial/ commercial grade or better. Residential types will be rejected.
  - 1. EP Switches: Landis & Gyr Powers, Inc. Series 265 - Junction Box Type or approved equal.
  - 2. Relays: Relays shall have an LED status indicator, voltage transient suppression, Closed-Open-Auto switch, plastic enclosure, and color coded wires. Kele model RIBU1C or approved equal.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF CONTROL SYSTEMS

- A. General: Install systems and materials in accordance with manufacturer's instructions, roughing-in drawings and details shown on drawings.
  
- B. Control Air Piping:
  - 1. All control air piping shall be copper. Exception: Flexible Tubing may be used for a maximum of two (2) feet at connections to equipment (except for steam control valves) and inside control cabinets.
  - 2. Provide copper tubing with a maximum unsupported length of 3'-0".
  - 3. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
  - 4. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
  - 5. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
  - 6. All control tubing at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel.
  - 7. Provide pressure gages on each output device.
  - 8. Paint all exposed control tubing to match existing.
  
- C. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquidtight flexible conduit is limited to 36" to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.

- D. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
  2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
  3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
    - a. Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
  4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
    - a. Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
  5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.
- E. All low voltage electrical wiring shall be run as follows:
1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
  2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
  3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated and properly supported to building structure.
  4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.
- F. All devices shall be mounted appropriately for the intended service and location.
1. Adjustable thermostats shall be provided with base and covers in occupied areas and mounted 48" above finished floor to the top of the device. Tubing and/or wiring shall be concealed within the wall up to the ceiling wherever possible. Surface raceway may only be used with approval of Owners Representative. Wall mounted sensors such as CO<sub>2</sub>, RH, and non-adjustable temperature sensors shall be mounted 54" above finished floor. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
  2. All control devices shall be tagged and labeled for future identification and servicing of control system.
  3. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
  4. All field devices must be accessible or access panels must be installed.

- G. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.

3.2 ADJUSTING AND START-UP

- A. Start-Up: Temporary control of Air Handling Units shall be allowed only if approved by the owner's representative to protect finishes, etc., AHUs may be run using caution with temporary controls installed by contractor early in the startup process. All safeties including a smoke detector for shut down must be operational. Some means of discharge air control shall be utilized and provided by the contractor such as a temporary temperature sensor and controller located and installed by the Contractor.

- B. The start-up, testing, and adjusting of pneumatic and digital control systems will be conducted by owner. Once all items are completed by the Contractor for each system, Contractor shall allow time in the construction schedule for owner to complete commissioning of controls before project substantial completion. This task should be included in the original schedule and updated to include the allotted time necessary to complete it. As a minimum, the following items are required to be completed by the Contractor for Owner to begin controls commissioning.

- 1. Process Control Network:

- a. The control boards and enclosures need to be installed in the mechanical rooms.
- b. The fiber optic conduit and box for the process control network needs to be installed. Once in place, Owner needs to be contacted so the length of the owner provided fiber cable can be determined and ordered, if required. Coordinate with Owner to schedule the pull in and termination of the fiber cable. Power should be in place at that time. (Fiber for the process control network is required to allow metering of utilities prior to turn on.)

- 2. Heating System:

- a. Pumps, heat exchangers, steam pressure reducing station, piping, control valves, steam and/or hot water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, steam regulators set to required pressure, condensate pumps operational, heating system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.

- 3. VAVs-First Pass:

- a. Power, (FC or N2 bus), and control wire installed before owner can make first commissioning pass. First pass includes installation of VAV controller, termination of power, control and network communication wiring.

4. VAVs-Second Pass:

- a. After the air handlers are running and under static pressure control and the heating water system is operating, a second pass can be made on the VAVs to download the control program and commission controllers to verify the VAV dampers, thermostat, and reheat control valves are working properly.

5. Exhaust and Energy Recovery Systems:

- a. Exhaust fans need to be operational and under control before labs can be commissioned.

3.3 CLOSEOUT PROCEDURES

- A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.
- B. Contractor shall provide as built diagram of network bus routing listing all devices on bus, once wiring is complete prior to scope completion.

END OF SECTION 230900

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SECTION 232113 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes piping systems for hot water heating and chilled water cooling systems; makeup water for these systems; blow-down drain lines; and condensate drain piping. Piping materials and equipment specified in this Section include the following:
  - 1. Pipes, fittings, and specialties.
  - 2. Special-duty valves.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
  - 1. General Sections "Firestopping" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
  - 2. General Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
  - 3. Division 23 Section "Basic Mechanical Materials and Methods" for general piping materials and installation methods.
  - 4. Division 23 Section "Valves" for gate, globe, ball, butterfly, and check valves.
  - 5. Division 23 Section "Meters and Gages" for thermometers, flow meters, and pressure gages.
  - 6. Division 23 Section "Hangers and Supports" for pipe supports.
  - 7. Division 23 Section "Mechanical Identification" for labeling and identifying hydronic systems.
  - 8. Division 23 Section "Control Systems" for temperature-control valves and sensors.
  - 9. Division 23 Section "Testing, Adjusting, and Balancing" for hydronic system adjusting and balancing.

1.3 SYSTEM DESCRIPTION

- A. Hydronic systems are chilled water and hot water heating, forced, recirculating systems.

1.4 SUBMITTALS

- A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

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- B. Product Data including rated capacities of selected models, weights (shipping, installed, and operating), furnished specialties, accessories, and installation instructions for each hydronic specialty and special-duty valve specified.
  - 1. Submit flow and pressure drop curves for balancing valves, based on manufacturer's testing.
- C. Shop Drawings detailing pipe anchors, special pipe support assemblies, alignment guides, and expansion joints and loops.
- D. Field test reports indicating and interpreting test results for compliance with performance requirements specified in Part 3 of this Section.
- E. Maintenance data for hydronic specialties and special-duty valves to include in the operation and maintenance manual specified in Division 1.

## 1.5 QUALITY ASSURANCE

- A. ASME Compliance: Comply with the following provisions:
  - 1. ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
  - 2. Fabricate and stamp air separators and compression tanks to comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.
  - 3. Welding Standards: Qualify welding processes and operators according to ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."

## 1.6 COORDINATION

- A. Coordinate layout and installation of piping with equipment and with other installations.
- B. Coordinate pipe sleeve installation for foundation wall penetrations.
- C. Coordinate pipe fitting pressure classes with products specified in related Sections.
- D. Coordinate size and location of concrete housekeeping pads. Cast anchor-bolt inserts into pad. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- E. Coordinate installation of pipe sleeves for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Firestopping" for fire and smoke wall and floor assemblies.

## 1.7 EXTRA MATERIALS

- A. Maintenance Stock: Furnish a sufficient quantity of chemicals for initial system startup and for preventive maintenance for one year from Substantial Completion.



PART 2 - PRODUCT

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Balancing Valves:
    - a. Armstrong Pumps, Inc.
    - b. Nibco.
    - c. Tour & Anderson.
    - d. Nexus Valve.

2.2 PIPE AND TUBING MATERIALS

- A. General: Refer to Part 3 "Pipe Applications" Article for identifying where the following materials are used.
- B. Steel Pipe, 2-1/2-Inch NPS (DN50) and Smaller: All steel pipe shall be ASTM A53, Grade B, Type E. Welded fittings shall be the same material as the pipe.
- C. Steel Pipe, 3- to 12-Inch NPS (DN65 to DN300): All steel pipe shall be ASTM A53, Grade B, Type E. Welded fittings shall be the same material as the pipe.
  - 1. Steel Pipe Nipples: ASTM A 106 or ASTM A 53, Schedule 40, carbon steel, seamless for 2-inch NPS (DN50) and smaller and electric-resistance welded for 2-1/2-inch NPS (DN65) and larger.
- D. Steel pipe, 14- to 18-inch NPS (DN 350 to DN 450): All steel pipe shall be ASTM A53, Grade B, Type E. Welded fittings shall be the same material as the pipe.
- E. Contractor may, at his option, use Drawn-Temper Copper Tubing: ASTM B 88, Type L (ASTM B 88M, Type B) for chilled and hot water heating piping 2-1/2" and below.

2.3 FITTINGS

- A. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125.
- B. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300.
- C. Cast-Iron Threaded Flanges: ASME B16.1, Classes 125 and 250; raised ground face, bolt holes spot faced.
- D. Wrought-Steel Fittings: ASTM A 234 (ASTM A 234M), Standard Weight.

- E. Wrought-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.
  - 3. Facings: Cast iron with flat faced flanges, 125 lb. valves.
- F. Wrought-Copper Fittings: ASME B16.22.
- G. Wrought-Copper Unions: ASME B16.22.

2.4 JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, 95-5 tin antimony.
- B. Brazing Filler Metals: AWS A5.8, Classification Bag 1 (silver).
- C. Welding Materials: Comply with Section II, Part C of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.
- D. Gasket Material: Thickness, material, and type suitable for fluid to be handled; and design temperatures and pressures.
  - 1. Chilled Water: red rubber.
  - 2. Heating Water and Steam: Flexitaulic Flexicarb Style GC or equal.

2.5 VALVES

- A. Gate, globe, check, ball, and butterfly valves are specified in Division 23 Section "Valves."
- B. Refer to Part 3 "Valve Applications" Article for specific uses and applications for each valve specified.
- C. Balancing Valves (2" and Under): 200-psig (860-kPa) working pressure, 250 deg F (121 deg C) maximum operating temperature, bronze body, balancing valve with combination shutoff capability. Balancing valves shall have memory stop and pressure/temperature metering taps, with wheel handle and indicator. Furnish with portable test kit. Quarter turn valves will not be acceptable.
- D. Safety Relief Valves: Brass or bronze body with brass and rubber, wetted, internal working parts; according to ASME Boiler and Pressure Vessel Code, Section IV. See schedule on drawings for sizes.

2.6 HYDRONIC SPECIALTIES

- A. Manual Air Vent: Bronze body and nonferrous internal parts; 150-psig (1035-kPa) working pressure, 225 deg F (107 deg C) operating temperature; ½ ball valve.

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- B. Y-Pattern Strainers: 125-psig (860-kPa) working pressure; cast-iron body (ASTM A 126, Class B), flanged ends for 2-1/2-inch NPS (DN65) and larger, threaded connections for 2-inch NPS (DN50) and smaller, bolted cover, perforated Type 304 stainless-steel basket, and bottom drain connection.

## PART 3 - EXECUTION

### 3.1 PIPE APPLICATIONS

- A. Hot Water: 2-Inch NPS (DN50) and Smaller: Steel pipe with threaded joints.
  - 1. Copper piping may be utilized.
- B. Hot Water: 2-1/2-Inch NPS (DN65) and Larger: Steel pipe with welded and flanged joints.
- C. Drain Lines: Type L drawn-temper copper tubing with soldered joints.

### 3.2 VALVE APPLICATIONS

- A. General-Duty Valve Applications: Unless otherwise indicated, use the following valve types:
  - 1. Shutoff Duty: Use ball (up to 2") and butterfly valves (2-1/2" and larger).
  - 2. Throttling Duty: Use balancing valves.
- B. Install shutoff-duty valves at each branch connection to supply mains, at supply connections to each piece of equipment, and elsewhere as indicated.
- C. Install drain valves at low points in mains, risers, branch lines, and elsewhere as required for system drainage.
- D. Install safety relief valves on hot water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Pipe discharge to floor without valves. Comply with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

### 3.3 PIPING INSTALLATIONS

- A. Install piping according to Division 23 Section "Common Work Results for HVAC."
- B. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- C. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch NPS ball valve, and short 3/4-inch NPS threaded nipple and cap. Install manual air vents at all high points.
- D. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

- E. Install branch connections to mains using tee fittings in main with takeoff out bottom of main, except for up-feed risers with takeoff out top of main line.
- F. Install unions in pipes 2-inch NPS and smaller, adjacent to each valve, at final connections of each piece of equipment, and elsewhere as indicated. Unions are not required at flanged connections.
- G. Install flanges on valves, apparatus, and equipment having 2-1/2-inch NPS and larger connections.
- H. Install strainers on supply side of each control valve, pressure-reducing valve, pressure-regulating valve, solenoid valve, in-line pump, and elsewhere as indicated. Install 3/4-inch NPS nipple and ball valve in blow-down connection of strainers 2-inch NPS and larger.
- I. Provide temporary caps and covers over piping to prevent collection of dirt and debris during construction.
- J. Anchor piping as required to ensure proper direction of expansion and contraction.

### 3.4 HANGERS AND SUPPORTS

- A. General: Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports." Conform to requirements below for maximum spacing of supports.
- B. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet (6 m) in length.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal runs 20 feet (6 m) or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal runs 20 feet (6 m) or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
- C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
  - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  - 4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  - 5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
  - 6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
  - 7. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  - 8. NPS 6: Maximum span, 12 feet; minimum rod size, 1/2 inch.
  - 9. NPS 8: Maximum span, 12 feet; minimum rod size, 5/8 inch.
  - 10. NPS 10: Maximum span, 12 feet; minimum rod size, 3/4 inch.
- D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.

2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

- E. Support vertical runs of steel piping at a maximum span of 15 feet.
- F. Support vertical runs of drawn-temper copper piping at a maximum span of 10 feet.

### 3.5 PIPE JOINT CONSTRUCTION

- A. Refer to Division 23 Section " Common Work Results for HVAC " for joint construction requirements for soldered and brazed joints in copper tubing; threaded, welded, and flanged joints in steel piping; and solvent-welded joints for PVC and CPVC piping.

### 3.6 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in system, at heat-transfer coils, and elsewhere as required for system air venting.

### 3.7 FIELD QUALITY CONTROL

- A. Testing Preparation: Prepare hydronic piping according to ASME B31.9 and as follows:
  1. Leave joints, including welds, uninsulated and exposed for examination during test.
  2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  3. Flush system with clean water. Clean strainers.
  4. Isolate equipment that is not subjected to test pressure from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Flanged joints where blinds are inserted to isolate equipment need not be tested.
  5. Install relief valve set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Testing: Test hydronic piping as follows:
  1. Acceptance Testing: Perform hydrostatic tests on the hydronic piping in accordance with ANSI B 31.9 and as follows:
  2. Notify Owner's Representative 24 hours before required testing. All tests shall be conducted in the presence of the Owner's Representative.
  3. Flush system with clean water. Clean strainers.
  4. Minimum test pressure shall be 100 PSIG.
  5. Pressure gauge shall be min. 4" dia. Face, 0-160 PSIG, and shall be calibrated within 1 year of test date.
  6. Test pressure shall be held for 1 hour.
  7. Prepare reports for all tests and required corrective action.

8. Clean and flush hydronic piping systems. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine mesh strainers in pump suction diffusers.
9. System shall be operated for a minimum of 24 hours to demonstrate to the Owner's Representative that system is complete and operational.

3.8 ADJUSTING AND CLEANING

- A. After completing system installation, including outlet fittings and devices, inspect finish. Remove burrs, dirt, and construction debris, and repair damaged finishes including chips, scratches, and abrasions.
- B. Flush hydronic piping systems with clean water. Remove, clean, and replace strainer screens. After cleaning and flushing hydronic piping system, but before balancing, remove disposable fine-mesh strainers in pump suction diffusers.
- C. Mark calibrated nameplates of pump discharge valves after hydronic system balancing has been completed, to permanently indicate final balanced position.

3.9 COMMISSIONING

- A. Perform these steps before operating the system:
  1. Open valves to fully open position. Close coil bypass valves.
  2. Check air vents at high points of systems and determine if all are installed and operating freely (automatic type) or bleed air completely (manual type).
  3. Set temperature controls so all coils are calling for full flow.
  4. Check operation of automatic bypass valves.

END OF SECTION 232113

SECTION 233113 – METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
- 2. Single-wall round and flat-oval ducts and fittings.
- 3. Sheet metal materials.
- 4. Sealants and gaskets.
- 5. Hangers and supports.
- 6. Duct liner

B. Related Sections:

- 1. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible".
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:

- 1. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: CAD generated plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.
7. Refer to Section "Common Work Results for HVAC".

D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2004, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1-2004, Section 6.4.4 - "HVAC System Construction and Insulation."



PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

### 2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

F. Reinforcement Shapes and Plates: ASTM A 36, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

### 2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard".

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. CertainTeed Corporation; Insulation Group.
  - b. Johns Manville.
  - c. Knauf Insulation.

- 
- d. Owens Corning.
  - e. Maximum Thermal Conductivity:
    - 1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - 2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
  - 2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  - 3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - B. Insulation Pins and Washers:
    - 1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - 2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards – Metal and Flexible", Figure 2-19, "Flexible Duct Liner Installation".
    - 1. Adherer a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
    - 2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
    - 3. Butt transverse joints without gaps, and coat joint with adhesive.
    - 4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted0edge overlapping.
    - 5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
    - 6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
    - 7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
    - 8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      - a. Fan discharges.
      - b. Intervals of lined duct preceding unlined duct.
      - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

9. Terminate ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
  1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
  2. Tape Width: 3 inches.
  3. Sealant: Modified styrene acrylic.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  7. Service: Indoor and outdoor.
  8. Service Temperature: Minus 40 to plus 200 deg F.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
  10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Water-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Solids Content: Minimum 65 percent.
  3. Shore A Hardness: Minimum 20.
  4. Water resistant.
  5. Mold and mildew resistant.
  6. VOC: Maximum 75 g/L (less water).
  7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
  8. Service: Indoor or outdoor.
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- D. Solvent-Based Joint and Seam Sealant:
  1. Application Method: Brush on.
  2. Base: Synthetic rubber resin.
  3. Solvent: Toluene and heptane.
  4. Solids Content: Minimum 60 percent.
  5. Shore A Hardness: Minimum 60.
  6. Water resistant.
  7. Mold and mildew resistant.
  8. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  9. VOC: Maximum 395 g/L.

10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
  11. Service: Indoor or outdoor.
  12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
- E. Flanged Joint Sealant: Comply with ASTM C 920.
1. General: Single-component, acid-curing, silicone, elastomeric.
  2. Type: S.
  3. Grade: NS.
  4. Class: 25.
  5. Use: O.
  6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall be rated for 10-inch wg static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round and flat-oval ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts before external insulation is applied. Provide adequate sealing as required to meet duct leakage requirements.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

- A. Paint interior of metal ducts, for 24 inches length, that are visible through return and exhaust registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

- B. Leakage Tests:

- 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
- 2. Maximum Allowable Leakage: Duct system leakages shall not exceed 5% of design air flows. When systems are leak tested in section, the total cumulative leakage of the system shall not exceed 5%.
- 3. Test the following systems:
  - a. All supply air ducts and sections from air handling unit to terminal units.
  - b. All return air ducts and sections from grilles/registers to return/relief air fan.
  - c. 10% of supply air ductwork downstream of boxes, but not less than two systems.
  - d. Two exhaust air duct systems.
- 4. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
- 5. Test for leaks before applying external insulation.
- 6. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
- 7. Give seven days' advance notice for testing.

- C. Duct System Cleanliness Tests:

- 1. Visually inspect duct system to ensure that no visible contaminants are present.
- 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
  - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

- D. Duct system will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.



**3.8 DUCT CLEANING**

- A. Clean ductwork that was not continuously sealed from fabrication to post installation before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 23 Section "Air Duct Accessories" for access panels and doors.
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
  - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- C. Particulate Collection and Odor Control:
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- D. Clean the following components by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
  - 7. Dedicated exhaust and ventilation components and makeup air systems.
- E. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

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6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

## 3.9 START UP

- A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

## 3.10 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Supply Ducts:
  1. Downstream of Air Handling Units and Up to Terminal Units:
    - a. Pressure Class: Positive 6-inch wg.
  2. From Terminal Units to Outlets:
    - a. Pressure Class: Positive 1-inch wg.
  3. Ducts Located within Mechanical Equipment Rooms:
    - a. Pressure Class: Positive 4-inch wg.
- C. Return Ducts:
  1. All Ducts:
    - a. Pressure Class: Negative 4-inch wg.
- D. Exhaust Ducts:
  1. General Exhaust System Ducts:
    - a. Pressure Class: Negative 4-inch wg.
- E. Outdoor-Air Ducts:
  1. All Ducts:
    - a. Pressure Class: Positive or negative 1-inch wg.
- F. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: Galvanized steel or carbon steel coated with zinc-chromate primer.

G. Liner:

1. Return Air Boots and Supply Grille Plenums: Type II, 1 inch thick.

H. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Velocity 1000 fpm or Lower:
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
    - 2) Mitered Type RE 4 without vanes.
  - b. Velocity 1000 to 1500 fpm:
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
  - c. Velocity 1500 fpm or Higher:
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.

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- 3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
  - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or Welded.
- I. Branch Configuration:
- 1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
    - a. Rectangular Main to Rectangular Branch: 45-degree entry.
    - b. Rectangular Main to Round Branch: 45-degree square to round.
  - 2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
    - a. Combination Boot Tee.
    - b. 45-degree lateral.

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

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. Manual volume dampers.
- 2. Fire dampers.
- 3. Flange connectors.
- 4. Turning vanes.
- 5. Duct-mounted access doors.
- 6. Flexible connectors.
- 7. Flexible ducts.
- 8. Duct accessory hardware.

B. Related Sections:

- 1. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

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

- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

- 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

- a. Special fittings.
- b. Manual volume damper installations.
- c. Control damper installations.
- d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
- e. Wiring Diagrams: For power, signal, and control wiring.

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- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

## 1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.

## 1.5 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed, but not less than two.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653.
  - 1. Galvanized Coating Designation: G90.
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A 480, Type 304, and having a No. 2 finish for concealed ducts and D4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

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- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 MANUAL VOLUME DAMPERS

### A. Standard, Manual Volume Dampers:

1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Air Balance Inc.; a division of Mestek, Inc.
  - b. American Warming and Ventilating; a division of Mestek, Inc.
  - c. McGill AirFlow LLC.
  - d. METALAIRE, Inc.
  - e. Nailor Industries Inc.
  - f. Ruskin Company.
  - g. Vent Products Company, Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
  - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness, or 0.10 inch aluminum sheet channels.
  - b. Mitered and welded corners.
  - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
  - a. Multiple or single blade.
  - b. Parallel- or opposed-blade design.
  - c. Stiffen damper blades for stability.
  - d. Galvanized-steel, 0.064 inch thick, or roll-formed aluminum 0.10 inch thick.
6. Blade Axles: Galvanized steel or Nonferrous metal.
7. Bearings:
  - a. Molded synthetic or Stainless-steel sleeve.
  - b. Dampers shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel/Aluminum.

## 2.3 FIRE DAMPERS

- ### A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Air Balance Inc.; a division of Mestek, Inc.
  2. Arrow United Industries; a division of Mestek, Inc.

3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. McGill AirFlow LLC.
  6. METALAIRE, Inc.
  7. Nailor Industries Inc.
  8. Ruskin Company.
  9. Vent Products Company, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 inch thick and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

#### 2.4 FLANGE CONNECTORS

- A. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- B. Material: Galvanized steel.
- C. Gage and Shape: Match connecting ductwork.

#### 2.5 TURNING VANES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Ductmate Industries, Inc.
  2. Duro Dyne Inc.



3. METALAIRE, Inc.
4. SEMCO Incorporated.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.6 DUCT-MOUNTED ACCESS DOORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Flexmaster U.S.A., Inc.
5. Greenheck Fan Corporation.
6. McGill AirFlow LLC.
7. Nailor Industries Inc.
8. Ventfabrics, Inc.
9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

- a. Double wall, rectangular.
- b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
- c. Vision panel.
- d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
- e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:

- a. Access Doors Less Than 12 Inches Square: Two hinges and one compression latch.
- b. Access Doors up to 18 Inches Square: Two hinges and two compression latches
- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Ventfabrics, Inc.
4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel or 0.032-inch-thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz./sq. yd. (474 g/sq. m).
2. Tensile Strength: 450 lbf/inch (79 N/mm) in the warp and 340 lbf/inch (60 N/mm) in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F (Minus 55 to plus 260 deg C).

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

## 2.8 FLEXIBLE DUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Thermaflex.
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene or aluminized vapor-barrier film.
  1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.
- C. Flexible Duct Connectors:
  1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.
  2. Non-Clamp Connectors: Liquid adhesive plus tape.

## 2.9 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install fire and smoke dampers according to UL listing.
- G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream and downstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
  - 7. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream and downstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- H. Install access doors with swing against duct static pressure.
- I. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.

- 5. Body Access: 25 by 14 inches.
- 6. Body plus Ladder Access: 25 by 17 inches.
  
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
  
- K. Install flexible connectors to connect ducts to equipment.
  
- L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
  
- M. Connect flexible ducts to metal ducts with draw bands and adhesive plus sheet metal screws. Do not use flexible ducts through walls, partitions.
  
- N. Install duct test holes where required for testing and balancing purposes.
  
- O. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

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SECTION 233600 - AIR TERMINAL UNITS

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. Shutoff, dual-duct air terminal units.

1.3 SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
  - 2. Liners and adhesives.
  - 3. Sealants and gaskets.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
  - 2. Wiring Diagrams: For power, signal, and control wiring.
  - 3. Hangers and supports, including methods for duct and building attachment and vibration isolation.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- D. Field quality-control reports.
- E. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.

2. Instructions for adjusting software set points.

#### 1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1-2010, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

### PART 2 - PRODUCTS

#### 2.1 TERMINAL UNIT MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carnes.
  2. METALAIRE, Inc.
  3. Price Industries.
  4. Titus.
  5. Tuttle & Bailey.
  6. Nailor<sup>2</sup>

#### 2.2 DUAL-DUCT AIR TERMINAL UNITS

- A. Configuration: Two volume dampers inside unit casing with mixing attenuator section and control components inside a protective metal shroud.
- B. All units shall be furnished with pressure independent direct digital controls supplied and mounted by the Owner. Contractor shall provide data sheets on all components to be mounted, indicating component dimensions, mounting hardware and methods, as well as wiring and piping diagrams for each application identified by unit tag per the schedule in the drawings, to the terminal unit manufacturer.
- C. The controls shall be compatible with inlet and discharge velocity sensors supplied by the terminal manufacturer. The sensor shall be multi-point center averaging type, with a minimum of four measuring ports parallel to the take-off point from the sensor. Sensors with measuring ports in series are not acceptable. The sensor must provide a minimum differential pressure signal of .03" wg at inlet velocities of 500 fpm.
- D. Controls shall be field set by Owner/Balancer for the scheduled minimum and maximum flow rates. Flow measuring taps and flow curves will be supplied with each terminal for field balancing air flow. Each terminal shall be equipped with labeling showing unit location, size, and scheduled cfm.



- E. Casing: 0.034-inch, single wall.
  - 1. Casing Lining: Adhesive attached, 1/2-inch-thick, polyurethane foam fiber-free insulation complying with UL 181 erosion requirements, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
  - 2. Air Inlets: Round stub connections or S-slip and drive connections for duct attachment.
  - 3. Air Outlet: S-slip and drive connections.
  - 4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
  - 5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.
  
- F. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
  - 1. Maximum Damper Leakage: ARI 880 rated, 3 percent of nominal airflow at 3-inch wg inlet static pressure.

## 2.3 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Steel Cables: Galvanized steel complying with ASTM A 603.
- C. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

## 2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
  - 1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and ARI certification seal.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.5 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. Tests and Inspections:
  - 1. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- C. Air terminal unit will be considered defective if it does not pass tests and inspections.

3.6 COMMISSIONING

- A. Complete installation and startup checks according to manufacturer's written instructions.
- B. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
- C. Verify that controls and control enclosure are accessible.
- D. Verify that control connections are complete.
- E. Verify that nameplate and identification tag are visible.
- F. Verify that controls respond to inputs as specified.

END OF SECTION 233600

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SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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. Round ceiling diffusers.
2. Rectangular and square ceiling diffusers.
3. Louver face diffusers.
4. Linear bar diffusers.
5. Linear slot diffusers.
6. Linear floor diffuser plenums.
7. Adjustable bar registers and grilles.
8. Fixed face registers and grilles.

B. Related Sections:

1. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek company.
  2. Carnes.
  3. Krueger.
  4. METALAIRE, Inc.
  5. Price Industries.
  6. Titus.
  7. Tuttle & Bailey.
  8. Nailor<sup>2</sup>
- B. Round Ceiling Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Steel or Aluminum.
  3. Finish: Baked enamel, white unless noted otherwise.
  4. Face Style: Minimum three cone.
  5. Mounting: To match ceiling type.
  6. Pattern: Fully adjustable.
- C. Rectangular and Square Ceiling Diffusers:
1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Steel or Aluminum.
  3. Finish: Baked enamel, white unless noted otherwise.
  4. Face Size: 24 by 24 inches or 12 by 12 inches.
  5. Face Style: Minimum three cone.
  6. Mounting: To match ceiling type.
  7. Pattern: Adjustable.
- D. Louver Face Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Steel or Aluminum.
  3. Finish: Baked enamel, white unless noted otherwise.
  4. Face Size: As indicated on drawings.
  5. Mounting: To match ceiling type.
  6. Pattern: Adjustable core style.
  7. Accessories:
    - a. Adjustable pattern vanes.
    - b. Operating rod extension.

2.2 CEILING LINEAR SLOT OUTLETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek company.
  2. Carnes.
  3. Krueger.
  4. METALAIRE, Inc.
  5. Price Industries.
  6. Titus.
  7. Tuttle & Bailey.
- B. Linear Bar Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material: Aluminum or Stainless steel.
  3. Finish: Baked enamel, white or natural aluminum or polished stainless steel.
  4. Core Spacing Arrangement: As indicated on drawings.
  5. Deflection Vanes: Extruded construction fixed louvers with removable core.
  6. Frame: 1/2 inch wide.
  7. Mounting: Countersunk screw.
  8. Accessories: Blank-off strips where shown on drawings.
- C. Linear Slot Diffuser:
1. Devices shall be specifically designed for variable-air-volume flows.
  2. Material - Shell: Aluminum.
  3. Material - Pattern Controller and Tees: Aluminum.
  4. Finish - Face and Shell: Baked enamel, black.
  5. Finish - Pattern Controller: Baked enamel, black.
  6. Finish - Tees: Baked enamel, white.
  7. Slot Width/Number of Slots/Length: As indicated on drawings.

2.3 REGISTERS AND GRILLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Anemostat Products; a Mestek company.
  2. Carnes.
  3. Krueger.
  4. METALAIRE, Inc.
  5. Price Industries.
  6. Titus.
  7. Tuttle & Bailey.
- B. Adjustable Bar Register and Grille:
1. Material: Steel or Aluminum.
  2. Finish: Baked enamel, white unless noted otherwise.
  3. Face Blade Arrangement: Horizontal adjustable.

4. Core Construction: Integral.
5. Rear-Blade Arrangement: Vertical adjustable.
6. Frame: 1 inch wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade for register only.
9. Accessories:
  - a. Front-blade gang operator.

C. Fixed Face Register:

1. Material: Steel or Aluminum.
2. Finish: Baked enamel, white unless noted otherwise.
3. Face Arrangement: 1/2-by-1/2-by-1/2-inch grid.
4. Core Construction: Integral.
5. Frame: 1 inch wide.
6. Mounting: Countersunk screw.
7. Damper Type: Adjustable opposed blade for register only.
8. Accessory: Filter.

2.4 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.



3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

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SECTION 239100 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. This section specifies a system or part of a system being commissioned as defined in Section 019113 Commissioning. Refer to Section 019113 for additional requirements.

1.2 SUMMARY

- A. This Section includes solid-state, PWM, VFCs for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. BMS: Building management system.
- B. IGBT: Integrated gate bipolar transistor.
- C. LAN: Local area network.
- D. PID: Control action, proportional plus integral plus derivative.
- E. PWM: Pulse-width modulated.
- F. VFC: Variable frequency controller.

1.4 SUBMITTALS

- A. Product Data: For each type of VFC. Include dimensions, mounting arrangements, location for conduit entries, shipping and operating weights, and manufacturer's technical data on features, performance, electrical ratings, characteristics, and finishes.
- B. Shop Drawings: For each VFC.
  - 1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
    - a. Each installed unit's type and details.
    - b. Nameplate legends.
    - c. Short-circuit current rating of integrated unit.

- d. Listed and labeled for series rating of overcurrent protective devices in combination controllers by an NRTL acceptable to authorities having jurisdiction.
  - e. Features, characteristics, ratings, and factory settings of each motor-control center unit.
- 2. Wiring Diagrams: Power, signal, and control wiring for VFCs. Provide schematic wiring diagram for each type of VFC.
- C. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around VFCs where pipe and ducts are prohibited. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- D. Qualification Data: For manufacturer.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For VFCs, all installed devices, and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 007213 include the following:
  - 1. Routine maintenance requirements for VFCs and all installed components.
  - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- G. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.
- H. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed and arrange to demonstrate that dip switch settings for motor running overload protection suit actual motor to be protected.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
- B. Source Limitations: Obtain VFCs of a single type through one source from a single manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, minimum clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver VFCs in shipping splits of lengths that can be moved past obstructions in delivery path as indicated.
- B. Store VFCs indoors in clean, dry space with uniform temperature to prevent condensation. Protect VFCs from exposure to dirt, fumes, water, corrosive substances, and physical damage.
- C. If stored in areas subject to weather, cover VFCs to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation, capable of driving full load without derating, under the following conditions, unless otherwise indicated:
  - 1. Ambient Temperature: 0 to 40 deg C.
  - 2. Humidity: Less than 90 percent (noncondensing).
  - 3. Altitude: Not exceeding 1000 feet.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.8 COORDINATION

- A. Coordinate layout and installation of VFCs with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate features of VFCs, installed units, and accessory devices with pilot devices and control circuits to which they connect.
- C. Coordinate features, accessories, and functions of each VFC and each installed unit with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. ABB Power Distribution, Inc.; ABB Control, Inc. Subsidiary.
  - 2. Danfoss Inc.; Danfoss Electronic Drives Div.
  - 3. Eaton Corporation; Cutler-Hammer Products.

4. Siemens Energy and Automation; Industrial Products Division.
5. Square D.
6. Toshiba International Corporation.

## 2.2 VARIABLE FREQUENCY CONTROLLERS

- A. Description: NEMA ICS 2, IGBT, PWM, VFC; listed and labeled as a complete unit and arranged to provide variable speed of an NEMA MG 1, Design B, 3-phase induction motor by adjusting output voltage and frequency.
1. Provide unit suitable for operation of premium-efficiency motor as defined by NEMA MG 1.
- B. Design and Rating: Match load type such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- C. Output Rating: 3-phase; 6 to 60 Hz, with voltage proportional to frequency throughout voltage range.
- D. Unit Operating Requirements:
1. Input ac voltage tolerance of 380 to 500 V, plus or minus 10 percent.
  2. Input frequency tolerance of 50/60 Hz, plus or minus 6 percent.
  3. Minimum Efficiency: 96 percent at 60 Hz, full load.
  4. Minimum Displacement Primary-Side Power Factor: 96 percent.
  5. Overload Capability: 1.1 times the base load current for 60 seconds; 2.0 times the base load current for 3 seconds.
  6. Starting Torque: 100 percent of rated torque or as indicated.
  7. Speed Regulation: Plus or minus 1 percent.
- E. Isolated control interface to allow controller to follow control signal over an 11:1 speed range.
1. Electrical Signal: 4 to 20 mA at 24 V.
  2. Pneumatic Signal: 3 to 15 psig.
- F. Internal Adjustability Capabilities:
1. Minimum Speed: 5 to 25 percent of maximum rpm.
  2. Maximum Speed: 80 to 100 percent of maximum rpm.
  3. Acceleration: 2 to a minimum of 22 seconds.
  4. Deceleration: 2 to a minimum of 22 seconds.
  5. Current Limit: 50 to a minimum of 110 percent of maximum rating.
- G. Self-Protection and Reliability Features:
1. Input transient protection by means of surge suppressors.
  2. Under- and overvoltage trips; inverter overtemperature, overload, and overcurrent trips.
  3. Motor Overload Relay: Adjustable and capable of NEMA ICS 2, Class 10 performance.
  4. Notch filter to prevent operation of the controller-motor-load combination at a natural frequency of the combination.
  5. Instantaneous line-to-line and line-to-ground overcurrent trips.

6. Loss-of-phase protection.
  7. Reverse-phase protection.
  8. Short-circuit protection.
  9. Motor overtemperature fault.
- H. Multiple-Motor Capability: Controller suitable for service to multiple motors and having a separate overload relay and protection for each controlled motor. Overload relay shall shut off controller and motors served by it when overload relay is tripped.
- I. Automatic Reset/Restart: Attempts three restarts after controller fault or on return of power after an interruption and before shutting down for manual reset or fault correction. Bidirectional autospeed search shall be capable of starting into rotating loads spinning in either direction and returning motor to set speed in proper direction, without damage to controller, motor, or load.
- J. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped.
- K. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- L. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- M. Status Lights: Door-mounted LED indicators shall indicate the following conditions:
1. Power on.
  2. Run.
  3. Overvoltage.
  4. Line fault.
  5. Overcurrent.
  6. External fault.
- N. Panel-Mounted Operator Station: Start-stop and auto-manual selector switches with manual speed control potentiometer and elapsed time meter.
- O. Indicating Devices: Meters or digital readout devices and selector switch, mounted flush in controller door and connected to indicate the following controller parameters:
1. Output frequency (Hz).
  2. Motor speed (rpm).
  3. Motor status (running, stop, fault).
  4. Motor current (amperes).
  5. Motor torque (percent).
  6. Fault or alarming status (code).
  7. PID feedback signal (percent).
  8. DC-link voltage (VDC).
  9. Set-point frequency (Hz).
  10. Motor output voltage (V).

- P. Control Signal Interface:
1. Electric Input Signal Interface: A minimum of 2 analog inputs (0 to 10 V or 0/4-20 mA) and 6 programmable digital inputs.
  2. Pneumatic Input Signal Interface: 3 to 15 psig.
  3. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the BMS or other control systems:
    - a. 0 to 10-V dc.
    - b. 0-20 or 4-20 mA.
    - c. Potentiometer using up/down digital inputs.
    - d. Fixed frequencies using digital inputs.
    - e. RS485.
    - f. Keypad display for local hand operation.
  4. Output Signal Interface:
    - a. A minimum of 1 analog output signal (0/4-20 mA), which can be programmed to any of the following:
      - 1) Output frequency (Hz).
      - 2) Output current (load).
      - 3) DC-link voltage (VDC).
      - 4) Motor torque (percent).
      - 5) Motor speed (rpm).
      - 6) Set-point frequency (Hz).
  5. Remote Indication Interface: A minimum of 2 dry circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
    - a. Motor running.
    - b. Set-point speed reached.
    - c. Fault and warning indication (overtemperature or overcurrent).
    - d. PID high- or low-speed limits reached.
- Q. Communications: Provide an RS485 interface allowing VFC to be used with an external system within a multidrop LAN configuration. Interface shall allow all parameter settings of VFC to be programmed via BMS control. Provide capability for VFC to retain these settings within the nonvolatile memory.
- R. Manual Bypass: Magnetic contactor arranged to safely transfer motor between controller output and bypass controller circuit when motor is at zero speed. Controller-off-bypass selector switch sets mode, and indicator lights give indication of mode selected. Unit shall be capable of stable operation (starting, stopping, and running), with motor completely disconnected from controller (no load).
- S. Bypass Controller: NEMA ICS 2, full-voltage, nonreversing enclosed controller with across-the-line starting capability in manual-bypass mode. Provide motor overload protection under both modes of operation with control logic that allows common start-stop capability in either mode.
- T. Integral Disconnecting Means: NEMA AB 1, instantaneous-trip circuit breaker with lockable handle.



- U. Isolating Switch: Non-load-break switch arranged to isolate VFC and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
- V. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.

### 2.3 ACCESSORIES

- A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
- B. Push-Button Stations, Pilot Lights, and Selector Switches: NEMA ICS 2, heavy-duty type.
- C. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- D. Control Relays: Auxiliary and adjustable time-delay relays.
- E. Standard Displays:
  - 1. Output frequency (Hz).
  - 2. Set-point frequency (Hz).
  - 3. Motor current (amperes).
  - 4. DC-link voltage (VDC).
  - 5. Motor torque (percent).
  - 6. Motor speed (rpm).
  - 7. Motor output voltage (V).
- F. Historical Logging Information and Displays:
  - 1. Real-time clock with current time and date.
  - 2. Running log of total power versus time.
  - 3. Total run time.
  - 4. Fault log, maintaining last four faults with time and date stamp for each.
- G. Current-Sensing, Phase-Failure Relays for Bypass Controller: Solid-state sensing circuit with isolated output contacts for hard-wired connection; arranged to operate on phase failure, phase reversal, current unbalance of from 30 to 40 percent, or loss of supply voltage; with adjustable response delay.

### 2.4 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested VFCs before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs for compliance with requirements, installation tolerances, and other conditions affecting performance.
- B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Select features of each VFC to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; and duty cycle of motor, controller, and load.
- B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

- A. Anchor each VFC assembly to steel-channel sills arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and grout sills flush with mounting surface.
- B. Install VFCs on concrete bases.
- C. Comply with mounting and anchoring requirements specified in Section 260529 "Hangers and Supports for Electrical Systems."
- D. Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Section 262813 "Fuses."

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring according to Section 230553 "Identification for HVAC Piping and Equipment".
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- B. Bundle, train, and support wiring in enclosures.
- C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
  - 1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.
  - 2. Connect selector switches with control circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

### 3.6 CONNECTIONS

- A. Conduit installation requirements are specified in Division 26 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

### 3.7 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
  - 1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:
  - 1. Inspect controllers, wiring, components, connections, and equipment installation.
  - 2. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
  - 3. Report results in writing.
- C. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- D. Perform the following field tests and inspections and prepare test reports:
  - 1. Perform each electrical test and visual and mechanical inspection, except optional tests, stated in NETA ATS. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

### 3.8 COMMISSIONING

- A. Fully test all aspects of the Variable-Frequency Motor Controllers work.

B. Acceptance Check Sheet:

1. Prepare a check sheet that includes all points for all functions of the Variable-Frequency Motor Controllers as indicate on the point list included in the contract documents.
2. Submit the check sheet to the Engineer for approval.
3. The Engineer will use the check sheet or other means as the basis for acceptance of the Variable-Frequency Motor Controllers system.

C. Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

D. Coordination with project commissioning professional:

1. Provide allowance for assistance with project professional.

3.9 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain variable frequency controllers.

END OF SECTION 239100

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. MU Division of IT Telecommunications Construction Standards and Specifications apply to this section. The Contractor shall obtain the latest revision of document and install all cables, pathways, boxes, equipment, and hardware in a manner to conform with MU Standards and Specifications.

1.2 SUMMARY

- A. Section Includes:
  - 1. Electrical equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Grout.
  - 4. Coordination drawings.
  - 5. Project record drawings.
  - 6. Electrical demolition.
  - 7. Common electrical installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. All equipment furnished shall be U.L. Listed and labeled or equivalent approved.
- C. Comply with NFPA 70.
- D. Equipment Selection: Equipment of larger physical dimensions, higher capacities or ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical/electrical services are appropriately modified. Any additional costs as a result of these modifications shall be borne by the Contractor.

1.5 DELEVERY, STORAGE, AND HANDLING

- A. Deliver raceways in clean condition. Store to prevent entrance of dirt, debris and moisture.
- B. Protect stored raceways, wires, and connectors from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.6 INTERPRETATION OF THE DRAWINGS

- A. The drawings indicate diagrammatically the conduit runs and the apparatus served in a general way. No attempt has been made to show exact location of every box, fitting or conduit offset. Such items are to be provided and all wiring connections and home runs are to be made as required. Where conduit runs are shown terminating in arrows, such conduit runs shall be extended to panels/boards or other equipment. Where equipment is specified to be wired, make connections as shown on approved equipment wiring diagrams. Consult equipment approved shop drawings for location of outlets and for miscellaneous controls. Where wire sizes are shown on drawings, the wire size for each circuit shall be for the entire circuit.
- B. Where conduit is shown without wiring symbols, install one (1) hot (phase) wire, one (1) neutral wire, and one (1) ground wire.
- C. Provide full size neutral for each circuit.
- D. No more than three circuits shall be installed in a conduit.

1.7 TEMPORARY POWER

- A. The contractor shall make all provisions for and furnish and install all necessary conduit, wire, and distribution equipment for a complete temporary wiring system for use during construction of the building. Temporary wiring shall include a system of temporary lights and power distribution. Refer to Division 01.

1.8 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed.

- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- E. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

**1.9 LOCATION OF OUTLETS**

- A. Outlets are only approximately located on the construction drawings and great care must be used in the actual location of outlets by consulting architectural drawings and details and the various fixture drawings and by securing definite locations from the Architect.
- B. At various places where outlets are shown below exposed pipes or ducts, Contractor shall set outlet box to clear same by at least 12". Where outlets are installed over piping or ducts, outlets shall be moved so as to clear piping and ducts at no additional cost, using approved conduit and conduit fittings.
- C. Switch outlets shall generally be located on lock side of door. Check the latest general drawings on job for door swings before roughing in for switches.
- D. Check height of tile or similar wainscots and set switch outlet boxes so that same will clear top of wainscot or will come entirely within the wainscot.
- E. Wall outlets installed flush shall be provided with device (plaster) covers set to come flush with the finished surface.
- F. For electric water coolers, install box in accordance with manufacturer's shop drawings so that receptacle will be concealed by unit housing.
- G. For other equipment, provide electrical rough-in in accordance with the equipment installation instructions and architectural drawings.
- H. Do not use through-the-wall and back-to-back boxes.

**PART 2 - PRODUCTS**

**2.1 SLEEVES FOR RACEWAYS AND CABLES**

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

- a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
- b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.2 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.3 COORDINATION DRAWINGS

A. The contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:

- 1. Electrical equipment locations and clearances required.
- 2. Routing of main feeders and conduits (3" dia. and larger), cable trays and bus ducts.
- 3. Locations of items in ceiling such as light fixtures.

B. The contractor shall submit the CAD generated drawings to the contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by the contractor.

C. The contractor shall participate in coordination meetings when requested by the contractor.

## 2.4 PROJECT RECORD DRAWINGS

A. Drawings shall be furnished in electronic-media (CD-Rewritable type) and at-least one hard copy prints.

- 1. Format: Same CAD program, version and operating system as the original contract documents.
- 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw and add details and notations where applicable.

B. Identify and date each drawing and include the designation "PROJECT RECORD DRAWING" or "AS-BUILT DRAWING" in a prominent location.



PART 3 - EXECUTION

3.1 ELECTRICAL DEMOLITION

- A. Refer to Division 02 Section “Selective Demolition” for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove electrical systems, fixtures, devices, and components indicated to be removed. In general, remove all fixtures, raceways, cables, junction boxes, and equipment not utilized in new construction. For circuits disconnects, remove raceways and cables all way to the source. Label breakers/switches from where circuits have been removed as “SPARE”.
- C. Protect existing electrical equipment and installation indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- D. Accessible Work: Remove exposed electrical equipment and installations, indicated to be demolished, in their entirety.
- E. Abandoned Work: Cut and remove buried raceway and wiring, indicated to be abandoned in place, 2 inches below the surface of adjacent construction. Cap raceways and patch surface to match existing finish. Raceways shall not be abandoned within walls.
- F. Remove demolished material from Project site.
- G. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- H. Remove equipment to be salvaged, disconnect from power, and deliver to Owner as directed.

3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

- F. In general install raceways and boxes minimum 8" above hung ceiling. All raceways, boxes and equipment shall be independently supported from structure. Do not support from ductwork or piping.
- G. Where new devices are added to existing circuits, take readings prior to adding new devices, and submit to Architect for review. Do not proceed with new work until approved by Architect.

**3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping." For communications cable penetrations, comply also with requirements in Division 27 Section "Common Work Results for Communications."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 260500

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SECTION 260505 – ELECTRICAL TESTING

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 general requirements for electrical field testing and inspecting. Detailed requirements are specified in each Section containing components that require testing. General requirements include the following:
  - 1. Suitability of test equipment.
  - 2. Calibration of test instruments.
  - 3. Coordination requirements for testing and inspecting.
  - 4. Reporting requirements for testing and inspecting.
- B. Emergency systems shall be tested as specified herein.

1.3 QUALITY ASSURANCE

- A. The Electrical Contractor shall completely test and inspect all systems in accordance with the specifications and drawings. The Electrical Contractor shall certify that all systems are in complete working order prior to turning over the Owner.
- B. Except as modified by governing codes and by the contract documents, comply with the latest applicable provisions and latest recommendations of the following:
  - 1. NFPA.
  - 2. NEMA.
  - 3. NEC.
  - 4. IEEE.
  - 5. IPCEA.
  - 6. ANSI.
  - 7. UL.
  - 8. NECA.
  - 9. Local Fire Department.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 GENERAL TESTING

- A. It shall be the responsibility of this Contractor to furnish all testing instruments/equipment, materials and labor necessary to perform the following tests.
  - 1. After wires or cables are in place, but before being connected to devices and equipment, the system shall be tested for shorts, opens, intentional and unintentional grounds by means of wires in conduit that are shorted or unintentionally grounded shall be replaced.
  - 2. Voltage drops for panel and large feeders shall not exceed 3% hence the total voltage drop for a feeder and any branch circuit shall not exceed 5% of the service voltage. The test shall be made under design load or its' equal.
  - 3. Any wiring device or electrical apparatus in this contract, if grounded or shorted on an integral "line" part, shall be removed and the problem rectified.
  - 4. When required, complete test and inspection records shall be made and incorporated into a report for each piece of equipment tested. All readings taken shall be recorded. Four (4) copies shall be submitted to the Architect for approval.
  - 5. Notify the Architect, with minimum seven (7) days notice, about testing schedule.

3.2 WIRING TEST

- A. The wiring and cable tests shall be made before any circuits, main switches, motors, transformers or feeders are energized.
- B. Tests shall be made for continuity, identification and absence of shorts and grounds for each conductor. Both ends of a given conductor shall be identified alike. Before circuit terminal connections are made, continuity and identification of wiring shall be checked by means of a DC test device using a bell, light, meter, or buzzer.
- C. Insulation Resistance (IR) test shall be made using meggers at the following values:
  - 1. 208Y/120 Volt wiring at 500 Volts DC.
- D. Insulation resistance between phase conductors and neutral, phase conductors and ground shall not be less than the minimum requirements of 2000 meg-ohms.
  - 1. Wire terminations shall not be made to equipment (motors, MCCs, but ducts, etc.), until that piece of equipment has been tested and verified as specified in this section.
  - 2. Test motor feeders with motors disconnected, but with circuit breakers, switches or starters in the circuit opened so as to include only that portion of the feeder, required to be tested.
  - 3. Test lighting feeders with the circuit breakers and panelboards connected but with lighting branch circuit breakers or switches open so as to include only the branch circuit to be tested.

4. Contractor shall correct or replace any circuit which is defective or grounded and shall correct all other problems encountered by these tests. All defects whether due to faulty workmanship or material furnished by the Contractor shall be corrected under this section at the Contractor's expense.

3.3 LIGHTING TEST

- A. Check all lighting fixtures for proper operation. All Contractor supplied fixtures shall be 100% operable at no additional cost to the Owner. Repair cost to Owner-supplied fixtures shall not be the responsibility of the Contractor unless otherwise stated.
- B. Verify operation of Lighting Control Systems. Program time clocks per client's requirements, including holiday setbacks.

3.4 MOTOR TEST

- A. Perform motor tests in coordination with fire suppression, plumbing and HVAC contractors for motors furnished with their equipment.
- B. All 208/120V motors shall be "spot tested" with 500V DC in a similar manner. The minimum resistance to ground shall be 2000 meg-ohm (corrected to 20 degrees C). The Contractor shall record the ambient temperature of the motor and submit this value along with insulation resistance value. For motors from 7-½ to 20 HP, Contractor shall submit Dielectric Absorption Ratios. For motor above 20 HP, the Polarization Indexes of the motor shall also be submitted.
- C. Make the following checks on all motors prior to start up.
  1. Check motor nameplates for HP, speed, phase and voltages. Verify proper voltage available for terminal wiring.
  2. Check shaft for freedom of rotation.
  3. Verify that the motor is properly lubricated prior to energizing.
- D. Contractor shall furnish a proper sized heater for each overload relay.
- E. Make the following tests on all motors during or immediately after start-up:
  1. Check for proper shaft rotation.
  2. Check motor for smooth operation (vibration).
  3. Take a current reading using a clamp-on ammeter. (Record no-load readings and loaded readings).

3.5 PANELBOARD TESTS

- A. Test all equipment to be operated on the 208/120V system at 500V DC prior to connecting feeders. A minimum insulation resistance of 2000 meg-ohms shall be obtained between all phases and between phase and neutral, and phase and ground.

3.6 SPOT TEST

- A. "Spot Test" mentioned in this section shall be interpreted as the specific test method of obtaining insulation resistance by applying indicated test voltage for 60 seconds to the equipment or wiring being tested.

3.7 CONTROL WIRING/OUTLET TEST

- A. Control wiring shall perform the function as noted in operation methods and/or included schematics and single line diagrams.
- B. All 120-volt outlets shall be tested with a Daniel Woodhead Cat. No. 1750 and 1760 tester. Minimum acceptable tension is 10 oz. for receptacles.

END OF SECTION 260505



SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

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. Building wires and cables rated 600 V and less.
  - 2. Connectors, splices, and terminations rated 600 V and less.
  - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
  - 1. Division 27 Section "Communications Horizontal Cabling" for cabling used for voice and data circuits.
- C. Pre-wired systems such as type AC (armored cable), type MC (metal-clad and type NM (nonmetallic-sheathed cable) shall not be used. (Exception: MC may be used for lighting fixture whips up to 6'-0" long. They must be dedicated, not daisy chained together).

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- B. 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.
- C. Comply with NFPA 70.
- D. All conductors and cables shall be UL labeled.

1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- B. Coordinate layout and installation of conductors and cables with other trades.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Delivery conductors and cables according to NEMA WC 26.
- B. Protect stored conductors and cables from moisture and dirt. Do not store outside, exposed to elements. Elevate above grade. Do not exceed structural capacity of floor, when stored inside.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Encore Wire and Cable.
  - 2. Senator Wire & Cable Company.
  - 3. Southwire Company.
  - 4. Cerro Wire.
- B. Copper Conductors: Comply with NEMA WC 70.
- C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN and XHHW.

- D. Multiconductor Cable: Comply with NEMA WC 70 for metal-clad cable, Type MC or mineral-insulated, metal-sheathed cable, Type MI with ground wire.

## 2.2 CONNECTORS AND SPLICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. AMP Incorporated/Tyco International.
  - 3. Hubbell Power Systems, Inc.
  - 4. O-Z/Gedney; EGS Electrical Group LLC.
  - 5. 3M; Electrical Products Division.
  - 6. Panduit Corporation.
  - 7. Tyco Electronics Corp.
- B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 3 - EXECUTION

### 3.1 CONDUCTOR MATERIAL AND SIZE APPLICATIONS

- A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. Conductors smaller than No. 12 AWG shall not be utilized anywhere, unless specifically noted on drawings.
- D. The minimum conductor size for branch circuits shall be #12 AWG copper. To compensate for voltage drop, where branch circuit lengths are between 100 and 150 feet, use #10 AWG copper. For branch circuit lengths exceeding 150 feet, use #8 AWG copper.

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- E. Wire size ampacity shall equal or exceed its overload protective device. Where wire sizes shown on the drawings are greater than the apparent ampacity requirements, the size shown shall prevail to compensate for voltage drop. In no instance shall conductors be installed that are less than required by NEC.

## 3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THWN, single conductors in raceway or Type XHHW, single conductors in raceway. Mineral-insulated, metal-sheathed cable, Type MI where specifically indicated on drawings.
- B. Exposed Feeders: Type THHN-THWN, single conductors in raceway.
- C. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- D. Feeders at all other locations: Type THHN-THWN, single conductors in raceway.
- E. Exposed Branch Circuits, Including in Crawlspace: Type THHN-THWN, single conductors in raceway.
- F. Branch Circuits below Slabs-on-Grade, and Underground: Type THHN-THWN, single conductors in raceway.
- G. Branch Circuits at all other locations: Type THHN-THWN, single conductors in raceway.
- H. Class 1 Control Circuits: Type THHN-THWN, in raceway.
- I. Class 2 Control Circuits: Type THHN-THWN, in raceway.
- J. Fire Alarm Circuits: Refer to Section 280513 "Conductors and Cables for Electronic Safety and Security".

## 3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal conduits in finished walls, and above ceilings, unless otherwise indicated.
- B. 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.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- D. Install exposed conduits parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.
- E. Support conduits according to Division 26 Section "Hangers and Supports for Electrical Systems."

- F. Identify and factory color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
- B. Make splices 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 and tap conductor for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

3.6 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.7 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and branch circuit conductors for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each splice in cables and conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner.
    - a. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of final acceptance.
    - b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING 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.
- B. MU Division of IT Telecommunications Construction Standards and Specifications apply to this section. The Contractor shall obtain the latest revision of document and install all cables, pathways, boxes, equipment, and hardware in a manner to conform with MU Standards and Specifications.

1.2 SUMMARY

- A. This Section includes methods and materials for grounding systems and equipment.
- B. This Section includes grounding of electrical systems and equipment and basic requirements for grounding for protection of life, equipment, circuits, and systems. Grounding requirements specified in this Section may be supplemented in other Sections of these Specifications.
- C. Related Sections include the following:
  - 1. Division 26 Section 260519 “Low-Voltage Electrical Power Conductors and Cables” for requirements for grounding conductors.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control test reports.
- C. Operation and Maintenance Data: For grounding to include the following in operation and maintenance manuals:
  - 1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems based on NFPA 70B.
    - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
    - b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. 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.
- C. Comply with UL 467 for grounding and bonding materials and equipment.
- D. Communications Grounding shall comply with BICSI Telecommunications Distribution Methods Manual (TDMM) and BICSI Information Transport Systems Installation Methods Manual, latest editions.

PART 2 - PRODUCTS

2.1 CONDUCTORS

- A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
  - 4. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 5. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.
  - 1. Telecommunications Ground Busbar (TGB) shall have industry-standard 2-hole pattern, and be 4 inches wide, as manufactured by CPI # 40153-012 or approved equivalent.

2.2 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.



- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.
  - 2. Telecommunications Grounding Connector Lugs: Irreversible compression type, 2-hole lug, for connection to TGBs. Approved manufacturers: Burndy, Panduit, Thomas & Betts.
- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions. All concealed terminations to the grounding electrode shall be made using exothermic welds.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger, unless otherwise indicated.
- B. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

3.2 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.

- C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

3.3 INSTALLATION

- A. Ground electrical systems and equipment according to NEC requirements, except where Drawings or Specifications exceed NEC requirements.

- B. Grounding Conductors: Route along shortest and straightest paths possible, minimizing direction changes and utilizing wide-radius bends where direction changes are necessary, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- E. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
  - 2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  - 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- G. The complete metal conduit system shall be used for the equipment grounding system. Conduit systems and associated fittings and terminations shall be made mechanically tight to provide a continuous electrical path to ground and shall be safely grounded at all equipment by bonding all metallic conduit to the equipment enclosures with locknuts cutting thru paint of enclosures. Bond all conduits entering primary switchgear, unit substations and secondary switchboards with a ground wire connecting the grounding type bushings to the equipment ground bar. Conductors shall be sized per NEC.
- H. In addition to using the conduit system for grounding, a complete auxiliary green wire equipment grounding system shall be installed, continuous from main ground, through distribution and branch circuit panelboards and paralleling all feeders and branch circuit wiring. The minimum size shall be #12 copper except #14 on control circuits. This shall apply to all circuits rated 100 volts or more above ground potential.

- I. Bond all communications conduit systems to ground.
- J. Connect ground terminal on wiring devices to auxiliary green wire equipment grounding system.
- K. Motor frames shall be bonded to the equipment grounding system by an independent green wire, sized as shown.
- L. System neutral connections shall be insulated from metal enclosures except at the neutral of the service entrance equipment. Connections to the main switchboard enclosure shall be by means of bonding jumpers.
- M. The building neutral shall be identified throughout with white conductors.
- N. Metal covers on pull boxes and junction boxes shall be effectively grounded.
- O. Wiring devices shall be connected with grounding jumper from ground pole on device to grounding screw in the outlet box.

### 3.4 CONNECTIONS

- A. General: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, and connection methods so metals in direct contact will be galvanically compatible.
  - 1. Use electroplated or hot-tin-coated materials to assure high conductivity and to make contact points closer in order pf galvanic series.
  - 2. Make connections with clean, bare metal at points of contact.
  - 3. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Complete with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- C. Equipment Grounding-Wire Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- D. Noncontact Metal Raceway Terminations: Where metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at both entrances and exits with grounding bushings and bare grounding conductors, except as otherwise indicated.
- E. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. Where these requirements are not available, use those specified in UL 486A and UL 486B.

- F. Compression-Type Connections: use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by manufacturer of connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- G. Moisture Protection: Where insulated grounding conductors are connected to grounding rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
  - 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  - 2. Test completed grounding system. The maximum ground-resistance level shall not exceed 5 ohms.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  - 3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
  - 1. Power and Lighting Equipment or System: 5 ohms.
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 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. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.
- B. Related Sections include the following:
  - 1. Division 26 Section "Vibration and Seismic Controls For Electrical Systems" for products and installation requirements necessary for compliance with criteria.
- C. All conduit shall be supported from the building. Attachment to other pipes, conduits, ductwork, etc. will not be allowed.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

- A. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

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## 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze hangers. Include Product Data for components.
  - 2. Steel slotted channel systems. Include Product Data for components.
  - 3. Nonmetallic slotted channel systems. Include Product Data for components.
  - 4. Equipment supports.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases.

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  5. Channel Dimensions: Selected for applicable load criteria.
- B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch-diameter holes at a maximum of 8 inches o.c., in at least 1 surface.
1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. Fabco Plastics Wholesale Limited.
    - d. Seasafe, Inc.
  2. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
  3. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.
  4. Rated Strength: Selected to suit applicable load criteria.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. 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.
- E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.
- F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36, steel plates, shapes, and bars; black and galvanized.
- G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
5. Toggle Bolts: All-steel springhead type.
6. Hanger Rods: Threaded steel.

## 2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

## PART 3 - EXECUTION

### 3.1 APPLICATION

- A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

### 3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.



- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
  - 1. To Wood: Fasten with lag screws or through bolts.
  - 2. To New Concrete: Bolt to concrete inserts.
  - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  - 4. To Existing Concrete: Expansion anchor fasteners.
  - 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
  - 7. To Light Steel: Sheet metal screws.
  - 8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### 3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS D1.1/D1.1M.

### 3.4 PAINTING

- A. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

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SECTION 260533 - RACEWAY AND BOXES 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.
- B. MU Division of IT Telecommunications Construction Standards and Specifications apply to this section. The Contractor shall obtain the latest revision of document and install all cables, pathways, boxes, equipment, and hardware in a manner to conform with MU Standards and Specifications.

1.2 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. All empty conduit shall be furnished with a pull string.

1.3 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. ENT: Electrical nonmetallic tubing.
- C. FMC: Flexible metal conduit.
- D. IMC: Intermediate metal conduit.
- E. LFMC: Liquidtight flexible metal conduit.
- F. LFNC: Liquidtight flexible nonmetallic conduit.
- G. RNC: Rigid nonmetallic conduit.
- H. RMC: Rigid metal conduit (rigid steel conduit).

1.4 SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

- B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Custom enclosures and cabinets.
- C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  - 1. Structural members in the paths of conduit groups with common supports.
  - 2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

#### 1.5 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.

### PART 2 - PRODUCTS

#### 2.1 METAL CONDUIT AND TUBING

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Allied Tube & Conduit; a Tyco International Ltd. Co.
  - 2. Republic Conduit.
  - 3. Western Tube and Conduit.
  - 4. Wheatland Tube Company.
- B. Rigid Steel Conduit: ANSI C80.1.
- C. IMC: ANSI C80.6.
- D. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
  - 1. Comply with NEMA RN 1.
  - 2. Coating Thickness: 0.040 inch, minimum.
- E. EMT: ANSI C80.3.
- F. FMC: Zinc-coated steel.
- G. LFMC: Flexible steel conduit with PVC jacket.

- H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
  - 1. Fittings for EMT: Steel or die-cast, compression type, and rated for ground connection.
  - 2. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
- I. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

## 2.2 NONMETALLIC CONDUIT AND TUBING

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. AFC Cable Systems, Inc.
  - 2. Anamet Electrical, Inc.; Anaconda Metal Hose.
  - 3. CANTEX Inc.
  - 4. CertainTeed Corp.; Pipe & Plastics Group.
  - 5. Condux International, Inc.
  - 6. Lamson & Sessions; Carlon Electrical Products.
  - 7. Manhattan/CDT/Cole-Flex.
  - 8. RACO; a Hubbell Company.
  - 9. Thomas & Betts Corporation.
- B. ENT: NEMA TC 13.
- C. RNC: NEMA TC 2, Type EPC-40-PVC, unless otherwise indicated.
- D. LFNC: UL 1660.
- E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.
- F. Fittings for LFNC: UL 514B.

## 2.3 METAL WIREWAYS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper B-Line, Inc.
  - 2. Hoffman.
  - 3. Keystone/Rees Inc.
  - 4. Square D; Schneider Electric.
- B. Description: Sheet metal sized and shaped as indicated, NEMA 250, Type 3R, unless otherwise indicated.

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- 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: Screw-cover type. Flanged-and-gasketed type where shown on drawings.
- E. Finish: Manufacturer's standard enamel finish.

## 2.4 BOXES, ENCLOSURES, AND CABINETS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
  - 2. EGS/Appleton Electric.
  - 3. Erickson Electrical Equipment Company.
  - 4. Hoffman.
  - 5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
  - 6. O-Z/Gedney; a unit of General Signal.
  - 7. RACO; a Hubbell Company.
  - 8. Thomas & Betts Corporation.
  - 9. Walker Systems, Inc.; Wiremold Company (The).
- B. Pull and junction boxes shall be minimum 4" x 4".
- C. Communications back-boxes for outlets shall be 4" x 4", 2-1/2" depth, with 2" x 4" single-gang reducer for single-gang faceplate mounting. Joint/shared boxes for power and Communications are not allowed.
- D. Sheet Metal Outlet and Device Boxes: NEMA OS 1.
- E. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
- F. Nonmetallic Outlet and Device Boxes: NEMA OS 2.
- G. Metal Floor Boxes: Cast or sheet metal, fully adjustable, rectangular.
- H. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- I. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, with gasketed cover.
- J. Hinged-Cover Enclosures: 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. Nonmetallic Enclosures: Plastic, finished inside with radio-frequency-resistant paint.
- K. Cabinets:
  - 1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.
3. Key latch to match panelboards.
4. Metal barriers to separate wiring of different systems and voltage.
5. Accessory feet where required for freestanding equipment.

2.5 SLEEVES FOR RACEWAYS

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

- A. Comply with the following indoor applications, unless otherwise indicated:
  1. Exposed, Not Subject to Physical Damage: EMT.
  2. Exposed and Subject to Physical Damage: Rigid steel conduit or IMC. Includes raceways in the following locations:
    - a. Loading dock.
    - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
    - c. Mechanical rooms.
    - d. Electrical rooms.
    - e. Stairwells.
    - f. Within block or masonry walls.
  3. Concealed Above Hung Ceilings and Within Interior Sheet Rock Walls and Partitions: EMT.
  4. Underground Conduit: Rigid steel conduit or IMC, below concrete. Conduit is not allowed within poured concrete.
  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. Length not to exceed 6 ft.
  6. Damp or Wet Locations: Rigid steel conduit.
  7. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: Plenum-type, optical fiber/communications cable raceway or EMT.
  8. Raceways for Optical Fiber or Communications Cable Risers in Vertical Shafts: EMT.
  9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.

- B. Concealed: FMC ½" inch – only in specific locations, in existing areas, within existing walls to remain. Utilize only between box in wall to junction box above ceiling. Junction box shall be located within 12" above hung ceiling. FMC, within walls, not acceptable in other locations.
- C. Minimum Raceway Size: 3/4-inch trade size, except for Communications cabling which shall be minimum raceway size 1-inch.
- D. Raceway Fittings: Compatible with raceways and suitable for use and location.
  - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
  - 2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
- E. Install raceways underground or below floor only for locations indicated on drawings.

### 3.2 INSTALLATION

- A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.
- B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping. Do not install horizontal raceway directly and parallel under cold water or chilled water pipes. In general, install raceways as high as possible, closer to underside of structure. Install horizontal raceways minimum 8 inches above ceilings.
- C. Complete raceway installation before starting conductor installation.
- D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."
- E. Install temporary closures to prevent foreign matter entering the raceways.
- F. Arrange stub-ups so curved portions of bends are not visible above the finished slab.
- G. Install no more than the equivalent of three 90-degree bends in any conduit run.
- H. Conceal conduit and EMT within finished walls and ceilings, unless otherwise indicated.
- I. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
  - 1. Run parallel or banked raceways together on common supports.
  - 2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.
- J. Join raceways with fittings designed and approved for that purpose and make joints tight.
  - 1. Use insulating bushings to protect conductors.



- K. Utilize compression fittings only with suitable tools.
- L. Raceways embedded in slabs is not allowed.
- M. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.
- P. Terminations: Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against the box. Where terminations are not secure with one (1) locknut, use two (2) locknuts: one (1) inside and one (1) outside the box.
- Q. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into the hub so the end bears against the wire protection shoulder. Where chase nipples are used, align raceways so the coupling is square to the box and tighten the chase nipple so no threads are exposed.
- R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.
- S. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic and nonmetallic, rigid and flexible, as follows:
  - 1. Raceway shall be sized to include minimum 33% spare cable capacity for future adds.
  - 2. 1-Inch Trade Size and Larger:
    - a. Install raceways in maximum lengths of 150 feet.
    - b. Install with a maximum of three 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements.
    - c. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.
  - 3. Conduits shall not be daisy-chained together.
  - 4. Conduit inside bend radius must be:
    - a. 2" Trade size and smaller conduit: minimum bend radius of six times the conduit inside diameter.
    - b. Larger than 2" Trade size conduit: minimum bend radius of 10 times the conduit inside diameter.
  - 5. Conduit fill limits in terms of maximum number of Category 6 cables shall be as follows:
    - a. 1" Conduit: 5 cables
    - b. 1-1/4" Conduit: 8 cables
    - c. 1-1/2" Conduit: 11 cables

- d. 2" Conduit: 20 cables
  - e. 3" Conduit: 47 cables
  - f. 4" Conduit: 84 cables
6. Maintain following minimum clearances from cable pathways, to avoid electromagnetic interference, from the following:
- a. Motors and transformers: 4-feet
  - b. Conduit and cables used for electrical power distribution: 1-foot
  - c. Fluorescent lighting: 5-inches
7. Pull boxes shall be placed directly after a bend where possible, or sized accordingly if the pull box is located at the bend.
8. 1-inch minimum conduit shall extend from outlet backbox, to above accessible ceiling with minimum 12-inches clearance above ceiling, turn 90-degrees, and be reamed and installed with a nylon insulated bushing to avoid damage to cables. This conduit must terminate before passing through a fire rated wall.
9. When using architect- and owner- approved surface mount raceway, a Wiremold # 5744S outlet box or approved equal shall be provided. Dual channel raceway such as Wiremold 4000 shall use a V/G4007C-1 device plate.
- T. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
- 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
  - 2. Where otherwise required by NFPA 70.
- U. Expansion-Joint Fittings: Install UL approved expansion fittings in each run of aboveground conduit that is located at building expansion joint. Length of fittings shall not exceed 6 inches.
- V. Flexible Conduit Connections: Use maximum of 72 inches of flexible conduit from junction boxes to recessed and semirecessed lighting fixtures, 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. Flexible conduit from light fixture to lighting fixture not allowed.
- 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.
- X. Set metal floor boxes level and flush with finished floor surface.
- Y. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
- Z. All raceways terminating a junction boxes, located above ceiling shall be provided with color coded vinyl tape indicating the service. Color coding tape shall be applied next to the junction box. Tape color shall match junction box cover color.

- AA. The height of the center of outlets above the finished floor, if not otherwise specified or shown on drawings, shall be as following:

Lighting Brackets .....	As indicated on drawings	
Switch Outlets.....	3'-10" to centerline	
Convenience Receptacle .....	1'-6" (1'-3" to bottom of box)	*
Telephone Outlet .....	1'-6" (1'-3" to bottom of box)	*
Data Outlet .....	1'-6" (1'-3" to bottom of box)	*
Wall Telephone Outlet.....	3'-10" to centerline	**
Fire Alarm Manual Pull Stations .....	3'-10" to centerline	
Audio /Visual Alarms .....	6'-8" to bottom of device	***

\* Minimum height of 1'-3" to meet ADA Standards

\*\* Mount at 5'-6" in Mechanical Rooms

\*\*\* Maximum of 6' below finished ceiling whichever is least unless shown or indicated otherwise

Note: Where receptacles are shown installed above countertops, mount receptacles no less than 6" centerline above tops of splash back. See architectural elevations case work shop drawings for determining exact heights.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both surfaces of walls.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

3.4 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

- A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
  - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
  - 2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.6 CLEANING

- A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes. Remove burrs, dirt, and construction debris.

END OF SECTION 260533

SECTION 260548 - VIBRATION AND SEISMIC CONTROLS 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. This Section includes the following:
  - 1. Channel support systems.
  - 2. Restraint cables.
  - 3. Hanger rod stiffeners.
  - 4. Anchorage bushings and washers.
- B. Related Sections include the following:
  - 1. Division 26 Section "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 DEFINITIONS

- A. The IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.

1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
  - 2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
  - 3. Restrained-Isolation Devices: Include ratings for horizontal, vertical, and combined loads.

1.5 QUALITY ASSURANCE

- A. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

- B. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproval by ICC-ES, or preapproval by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. 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) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 SEISMIC-RESTRAINT DEVICES

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amber/Booth Company, Inc.
  - 2. Cooper B-Line, Inc.; a division of Cooper Industries.
  - 3. Hilti Inc.
  - 4. Mason Industries.
  - 5. Unistrut; Tyco International, Ltd.
- B. General Requirements for Restraint Components: Rated strengths, features, and application requirements shall be acceptable to authorities having jurisdiction.
  - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- C. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.
- D. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivels, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.
- E. Hanger Rod Stiffener: Reinforcing steel angle clamped to hanger rod. Do not weld stiffeners to rods.
- F. Bushings for Floor-Mounted Equipment Anchor: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchors and studs.
- G. 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.

- H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.
- I. Mechanical Anchor: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchors with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.
- J. Adhesive Anchor: Drilled-in and capsule anchor system containing polyvinyl 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.

## 2.2 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
  - 1. Powder coating on springs and housings.
  - 2. All hardware shall be galvanized. Hot-dip galvanized metal components for exterior use.
  - 3. Baked enamel or powder coat for metal components on isolators for interior use.
  - 4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapeze member with clamps approved for application.
- B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

- C. Strength of Support 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.

### 3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Equipment and Hanger Restraints:
  - 1. Install restrained isolators on electrical equipment.
  - 2. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
- B. 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.
- C. 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.
- D. 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.

### 3.4 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Remove and replace malfunctioning units and retest as specified above.
- C. Prepare test and inspection reports.

### 3.5 ADJUSTING

- A. Adjust isolators after isolated equipment is at operating weight.



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- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548

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SECTION 260553 - 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.
  - 8. Miscellaneous identification products.

1.3 SUBMITTALS

- A. Product Data: For each electrical identification product indicated.
- B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

- A. Comply with ANSI A13.1.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI Z535.4 for safety signs and labels.
- E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- B. Colors for Raceways Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

#### 2.4 CONDUCTOR IDENTIFICATION MATERIALS

- A. Color-Coding of Conductor Tape: All service, feeder and branch circuit conductors, rated for 600V or less shall be factory color-coded as specified herein. Field applied labels, tapes or bands not acceptable.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

#### 2.5 FLOOR MARKING TAPE

- A. 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

#### 2.6 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- C. Baked-Enamel Warning 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.
- D. Warning label and sign shall include, but are not limited to, the following legends:
  - 1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

#### 2.7 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.
  - 1. Engraved legend with black letters on white face.
  - 2. Punched or drilled for mechanical fasteners.
  - 3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 EQUIPMENT IDENTIFICATION LABELS

- A. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Minimum 0.0625 inch thick adhesive backed, with white letters on a black background. Minimum letter height shall be 3/8 inch.

2.9 JUNCTION/PULL BOX COVER IDENTIFICATION

- A. Paint all junction and pull box covers to identify service and voltage as follows:
  - 1. 120V Normal power – Green.
  - 2. Fire alarm System – Red.
- B. All covers shall identify circuit numbers, panel designation, voltage and service. Identification shall be done by black magic markers.

2.10 CABLE TIES

- A. 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.
- B. Plenum-Rated Cable Ties: Self extinguishing, UV stabilized, one piece, self locking.
  - 1. Minimum Width: 3/16 inch.
  - 2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
  - 3. UL 94 Flame Rating: 94V-0.
  - 4. Temperature Range: Minus 50 to plus 284 deg F.
  - 5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select 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 INSTALLATION

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. 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, within mechanical rooms, chiller rooms and boiler rooms.
- G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
  - 1. Outdoors: UV-stabilized nylon.
  - 2. In Spaces Handling Environmental Air: Plenum rated.
- H. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

- A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for All Service, All Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label or self-adhesive vinyl tape applied in bands. Install labels at 20-foot maximum intervals. The identification will include source board/panel and target board/panel. Use black letters on orange background.
- B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box as specified herein.
- C. Power-Circuit Conductor Identification, 600 V or Less: Factory color-code conductors as listed below:
  - 1. Colors for 208/120-V Circuits:
    - a. Phase A: Black.
    - b. Phase B: Red.
    - c. Phase C: Blue.

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- d. Neutral: White.
  - e. Ground: Green.
  - f. Switch Legs: Pink.
- D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.
- E. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  - 2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  - 3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels or Baked-enamel warning signs or Metal-backed, butyrate 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.
- I. 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.
- J. 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.



K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

- a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label or Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- b. Outdoor Equipment: Engraved, laminated acrylic or melamine label 4 inches high.
- c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
- d. Unless provided with self-adhesive means of attachment, fasten labels with
- e. Use appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
- f. The label shall include voltage, phases, number of wires, and board/switchgear/equipment served from. (Example: Panelboard BL-20-LN; 120/208 volts, 3 phase, 4 wire, served from board DP-B1-HN).

2. Equipment to Be Labeled:

- a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Enclosed switches.
- f. Enclosed circuit breakers.
- g. Enclosed controllers.
- h. Push-button stations.
- i. Contactors.
- j. Remote-controlled switches, dimmer modules, and control devices.
- k. Battery-inverter units.
- l. Monitoring and control equipment.

END OF SECTION 260553

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SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY AND ARC FLASH HAZARD ANALYSIS

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 computer-based, fault-current and overcurrent protective device coordination studies. Protective devices shall be set based on results of the protective device coordination study. The study shall include short circuit evaluation, device evaluation, device coordination and arc flash evaluation.
- B. The Owner shall be furnished short-circuit and protective device coordination studies as prepared by contractor.
- C. Contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in the current issue of NFPA 70E – Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002, the IEEE Guide for Performing Arc-Flash Calculations.
- D. The scope of the studies shall include the new electrical distribution equipment and feeder equipment shown on the plans. New equipment on sheet EP100 shall be added to existing SKM model provided by owner and labeled accordingly.
- E. Feeder Circuits:
  - 1. All three (3) phase feeder circuit protective devices installed with a rating equal to or greater than 30 amps.
- F. Branch Circuits:
  - 1. All three (3) phase branch circuit overcurrent protective devices installed with a rating equal to or greater than 30 amps.
  - 2. All motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.

1.3 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.

- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. The studies shall be submitted to the Owner and Engineer for review and approval prior to final completion.
- E. A preliminary Arc Flash Hazard Analysis shall be submitted to the Owner's Representative and Engineer with new electrical equipment submittals. **Equipment submittals will not be reviewed without the study specified herein.**
- F. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. A minimum of two (2) bound color copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided. Two (2) CDs containing all study files, including all device curves shall be provided (use the SKM "Project-Backup" command).
- G. The report shall include the following sections:
  - 1. Executive Summary including introduction, Scope of Work and Results / Recommendations.
  - 2. Short-Circuit Methodology, Analysis Results and Recommendations.
  - 3. Short-Circuit Device Evaluation Table.
  - 4. Protective Device Coordination Methodology Analysis Results and Recommendations.
  - 5. Protective Device Settings Table.
  - 6. Time-Current Coordination Graphs and Recommendations.
  - 7. Arc Flash Hazard Methodology Analysis Results and Recommendations including the details of the incident energy and flash protection boundary calculations, along with Arc Flash boundary distances, working distances, Incident Energy levels and Personal Protection Equipment levels.
  - 8. Arc Flashing Labeling section showing types of labels to be provided. Section will contain descriptive information as well as typical label images.
  - 9. One-line system diagram that shall be computer generated and will clearly identify individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location, devices numbers used in the time-current coordination analysis, and other information pertinent to the computer analysis.
- H. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals shall be in digital form.
  - 1. Coordination-study input data, including completed computer program input data sheets.
  - 2. Study and Equipment Evaluation Reports.
  - 3. Coordination-Study Report.
  - 4. Setting report.
  - 5. Arc flash calculations and report.

**1.4 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 not acceptable.
- B. Coordination-Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer. Submitted study shall bear the seal of the professional engineer.
- C. The Registered Professional Electrical Engineer shall be an employee of the approved firm providing the study.
- D. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.
- E. The approved firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analyses it has performed in the past year.
- F. The engineering firm shall have a minimum of ten (10) years of experience in performing power system studies.
- G. The study shall include the stamp or seal and signature of the preparing engineer and shall be reviewed and approved by the Engineer of Record.
- H. Comply with IEEE 242 for short-circuit currents and coordination time intervals.
- I. Comply with IEEE 399 for general study procedures.

**PART 2 - PRODUCTS**

**2.1 COMPUTER SOFTWARE DEVELOPERS**

- A. Acceptable Computer Software Developers: Subject to compliance with requirements, provide products by SKM Systems Analysis, Inc. only. The study shall be performed using SKM Systems Analysis Power Tools of Windows (PTW 32).

**2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

- C. 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.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled.

3.2 POWER SYSTEM DATA

- A. Gather and tabulate the following input data to support coordination study:
  - 1. Product Data for overcurrent protective devices specified in other Division 26 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. Impedance of utility service entrance.
  - 3. Electrical Distribution System Diagram: In two (2) hard-copy and two (2) CD electronic-copy formats, PDF submittals, showing the following (use SKM “project Backup” command):
    - a. Circuit-breaker and fuse-current ratings and types.
    - b. Relays and associated power and current transformer ratings and ratios.
    - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
    - d. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
    - e. Motor horsepower and code letter designation according to NEMA MG 1.
  - 4. 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. Ratings, types, and settings of utility company's overcurrent protective devices.
- e. Special overcurrent protective device settings or types stipulated by utility company.
- f. Time-current-characteristic curves of devices indicated to be coordinated.
- g. 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.
- h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
- i. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

### 3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
  - 1. Switchgear and switchboard bus.
  - 2. Motor-control center and starters.
  - 3. Distribution panelboard.
  - 4. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Utilize approved computer software program. Include studies of system-switching configurations and alternate operations that could result in maximum fault including arcing fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141 and IEEE 242.
  - 1. Transformers:
    - a. ANSI C57.12.10.
    - b. ANSI C57.12.22.
    - c. ANSI C57.12.40.
    - d. IEEE C57.12.00.
    - e. IEEE C57.96.
  - 2. Medium-Voltage Circuit Breakers: IEEE C37.010.
  - 3. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
  - 4. Low-Voltage Fuses: IEEE C37.46.

E. Study Report:

1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
2. Show momentary (1/2 cycle), interrupting (5-cycle), 30-cycle fault-current values for 3-phase, 2-phase and phase-to-ground faults and time-delayed currents (6 cycles and above) on medium-voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.

F. Equipment Evaluation Report:

1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
3. 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.

3.4 COORDINATION STUDY

A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.

1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
3. Calculate the maximum and minimum ground-fault currents.

B. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

C. Include on each TCC graph, a complete title with descriptive device names.

D. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

E. Identify the device associated with each curve by manufacturer type, function, and if applicable, tap, time delay, and instantaneous settings recommended.

F. Plot the following characteristics on the TCC graphs, where applicable.

1. Electric utility's overcurrent protective device.
2. Low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
3. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.
4. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.



5. Ground fault protective devices, as applicable.
  6. Pertinent motor starting characteristics and motor damage points, where applicable.
  7. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- G. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- H. Provide the following:
1. A one-line diagram shall be provided which clearly identified individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus.
  2. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.
  3. Computer printouts shall accompany the log-log plots and will contain descriptions for each of the devices shown, settings of the adjustable devices, and device identification numbers to aid in locating the devices on the log-log plots and the system one-line diagram.
  4. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram
  5. A discussion section which evaluates the degree of system protection and service continuity with overcurrent devices, along with recommendations as required for addressing system protection or device coordination deficiencies.
  6. Contractor shall notify Owner in writing of any significant deficiencies in protection and/or coordination. Provide recommendations for improvements.
- I. Comply with IEEE 141 and IEEE 242 recommendations for fault currents and time intervals.
- J. 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.
- K. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves 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.

- L. The protective device settings must address the need to minimize arc flash hazards while maintaining proper coordination.
- M. Coordination-Study Report: Prepare a written report indicating the following results of coordination study:
  - 1. Tabular Format of Settings Selected for Overcurrent Protective Devices:
    - a. Device tag.
    - b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
    - c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
    - d. Fuse-current rating and type.
    - e. Ground-fault relay-pickup and time-delay settings.
  - 2. Coordination Curves: Prepared to 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:
    - a. Device tag.
    - b. Voltage and current ratio for curves.
    - c. Three-phase and single-phase damage points for each transformer.
    - d. No damage, melting, and clearing curves for fuses.
    - e. Cable damage curves.
    - f. Transformer inrush points.
    - g. Maximum fault-current cutoff point.
- N. Completed data sheets for setting of overcurrent protective devices.
- O. Main service entrance switch shall be set to coordinate with utility company.

### 3.5 OVERCURRENT PROTECTIVE DEVICE SETTING

- A. Manufacturer's Field Service: Engage a factory-authorized service representative, of electrical distribution equipment being set and adjusted, to assist in setting of overcurrent protective devices within equipment.
- B. Testing: Perform the following device setting and prepare reports:
  - 1. After installing overcurrent protective devices and during energizing process of electrical distribution system, perform the following:
    - a. Verify that overcurrent protective devices meet parameters used in studies.
    - b. Adjust devices to values listed in study results.
  - 2. Adjust devices according to recommendations in Chapter 7, "Inspection and Test Procedures", and Tables 10.7 and 10.8 in NETA ATS.

3.6 ARC FLASH HAZARD ANALYSIS

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2009, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis and the protective device time-current coordination analysis.
- B. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, starters, panelboards) where work could be performed on energized parts.
- C. The analysis shall be based on the specific devices installed and include (but not be limited to) the following:
  - 1. Service Entrance Equipment:
    - a. All overcurrent protective devices installed in service entrance panels.
  - 2. Feeder Circuits:
    - a. All three (3) phase feeder circuit overcurrent protective devices installed with a rating equal to or greater than 30 amps.
  - 3. Branch Circuits:
    - a. All three (3) phase feeder circuit overcurrent protective devices installed with a rating equal to or greater than 30 amps.
    - b. All motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.
  - 4. Motor Control Centers:
    - a. All motor circuit overcurrent protective devices for motors with a rating equal to or greater than 10 horsepower.
- D. Working distances shall be based on IEEE 1685. The calculated arc flash protection boundary shall be determined using those working distances.
- E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

- F. The short-circuited calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.
  - 1. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.
  
- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Alternative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault coordination from motors should be decremented as follows:
  - 1. Fault contribution from induction motors should not be considered beyond 5 cycles.
  
- H. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear, and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment's main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.
  
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
  
- J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to complete the incident energy for the corresponding location.
  
- K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 Section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.
  
- L. Provide the following:
  - 1. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted and arcing fault current levels, flash protection boundary distances, working distances, personal-protective equipment classes and AFIE (Arc Flash Incident Energy) levels.
  - 2. The Arc-Flash Hazard Analysis shall report incident energy values based on recommended device settings for equipment within the scope of the study.
  - 3. The Arc-Flash Hazard Analysis may include recommendations to reduce AFIE levels and enhance worker safety.

3.7 FIELD ADJUSTMENT

- A. The contractor shall adjust relay and protective device settings according to the recommended setting table provided by the coordination study.
- B. The contractor shall make modifications to equipment as required to accomplish conformances with short circuit and protective device coordination studies.
- C. The Arc Flash Hazard Analysis shall be reviewed and updated to reflect any changes and corrections to conductor length within one week of the final electrical walk through for punch list.

3.8 ARC FLASH LABELS

- A. Contractor shall provide a 4.0 in. x 4.0 inc. thermal transfer type label of high adhesion polyester for each work location analyzed. The labels shall be waterproof.
- B. The labels shall be designated according to the following standards:
  - 1. UL969 – Standard for Marking and Labeling Systems.
  - 2. ANSI Z535.4 – Product Safety Signs and Labels.
  - 3. NFPA 70 (National Electric Code) – Article 110.16.
- C. The label shall include the following information:
  - 1. System Voltage.
  - 2. Location.
  - 3. Source Protective device name.
  - 4. Flash protection boundary.
  - 5. Arc-Flash Incident energy value (cal/cm<sup>2</sup>).
    - a. For incident energy values less than or equal to 40 cal/cm<sup>2</sup>, label shall indicate “WARNING” using black lettering on orange background.
    - b. For incident energy values greater than 40 cal/cm<sup>2</sup>, label shall indicate “DANGER” using white lettering with red background.
  - 6. Limited, restricted and prohibited Approach Boundaries.
  - 7. Study report number and issue date.
- D. Labels shall be printed by a thermal transfer type printer, with no field markings.
- E. Arc flash labels shall be provided for equipment as identified in the study and the respective equipment access areas per the following:
  - 1. Floor Standing Equipment: Labels shall be provided on the front of each individual section. Equipment requiring rear and/or side access shall have labels provided on each individual section access area. Equipment line-ups containing sections with multiple incident energy and flash protection boundaries shall be labeled as identified in the Arc Flash Analysis table.

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2. Wall Mounted Equipment: Labels shall be provided on the front cover or a nearby adjacent surface, depending upon equipment configuration.
  - a. General Use Safety labels shall be installed on equipment in coordination with the Arc Flash labels. The General Use Safety labels shall warn of general electrical hazards associated with shock, arc flash, and explosions, and instruct workers to turn off power prior to work
- F. Owner and engineer approved Arc Flash Hazard warning labels shall be furnished and installed by the contractor prior to project completion.
  1. Contractor shall provide preliminary Arc Flash label for owner's review prior to installation.

END OF SECTION 260573

SECTION 260923 - LIGHTING CONTROL DEVICES

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 lighting control devices:
  - 1. Indoor occupancy sensors.
  - 2. Digital Lighting/Receptacle Control System.
  - 3. Emergency shunt relays.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

1.5 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.

1.6 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  - 3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  - 4. 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.
  - 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  - 6. Bypass Switch: Override the on function in case of sensor failure.
  - 7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.



- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
  - 1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.
  - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
  - 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.
  
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
  - 1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
  - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
  - 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
  
- E. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
  - 1. Sensitivity Adjustment: Separate for each sensing technology.
  - 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

## 2.2 Digital Lighting/Receptacle Control System

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Legrand, Wattstopper.
  
- B. Description: Intelligent, distributed lighting control system with components that operate on a free-topology local network.
  - 1. Room Controller: Low-voltage, digital, controller for light(s) in a single area or room with the following features.
    - a. 120/277-volt input designed for LED lighting loads.
    - b. One (1) or two (2) relays rated 20 amps as indicated on drawings.

- c. 0-10V dimming capability as indicated on drawings.
      - d. Inputs for occupancy sensor and low-voltage wall switch(es).
    - 2. Occupancy Sensor: Low-voltage, digital, dual-technology ceiling-mount occupancy sensor with the following features.
      - a. 24 VDC input from digital network.
      - b. LCD display and pushbuttons for setting sensor and system parameters.
      - c. Two (2) RJ45 digital network ports.
      - d. Passive infrared (PIR) and ultrasonic technologies.
      - e. Infrared (IR) transceiver.
    - 3. Wall Switch: Low-voltage, digital, push-button wall control station, with number of button(s) indicated on plans, and the following features.
      - a. 24 VDC input from digital network.
      - b. Two (2) RJ45 digital network ports.
      - c. Infrared (IR) transceiver.
    - 4. Partition Interface and Wall Switch: Low-voltage, digital interface for movable room partition walls and push-button control station, with number of button(s) indicated on plans, and the following features.
      - a. 24 VDC input from digital network.
      - b. Four (4) input terminals for inputs from limit switches on movable walls.
      - c. Two (2) RJ45 digital network ports.
      - d. Infrared (IR) transceiver.
  - C. BAS and Security System Interface: Provide hardware interface to enable the BAS or Security System to control room or plug-load controllers.
- 2.3 EMERGENCY SHUNT RELAY
- A. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
    - 1. Coil Rating: 120 or 277 V.
- 2.4 CONDUCTORS AND CABLES
- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
  - B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

**PART 3 - EXECUTION**

**3.1 SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

**3.2 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables". Minimum conduit size shall be 3/4 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

**3.3 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems".
- B. Label time switches and contactors with a unique designation.

**3.4 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

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### 3.5 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of final acceptance by Owner, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

### 3.6 DEMONSTRATION

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls".
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training".

END OF SECTION 260923

SECTION 262726 - WIRING DEVICES

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. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Wall-box motion sensors.
  - 3. Wall-box dimmers.
  - 4. Wall-switch and exterior occupancy sensors.
  - 5. Floor service outlets, poke-through assemblies, service poles, and multioutlet assemblies.
- B. Related Sections include the following:
  - 1. Division 27 Section "Communications Horizontal Cabling" for workstation outlets.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. TVSS: Transient voltage surge suppressor.
- F. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.
- C. Field quality-control test reports.

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- D. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

## 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. 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.
- C. Comply with NFPA 70.

## 1.6 COORDINATION

- A. Receptacles for Owner-Furnished Equipment: Match plug configurations.
  - 1. Cord and Plug Sets: Match equipment requirements.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Service Outlet Assemblies: One for every 10 installed, but no fewer than one.
  - 2. Receptacles: One for every 20 installed, but no fewer than two.
  - 3. Snap Switches: One for every 20 installed, but no fewer than two.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Acceptable Manufacturers' Names: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices (Receptacles, Switches):
    - a. Cooper Wiring Devices.
    - b. Hubbell Incorporated; Wiring Device-Kellems.
    - c. Leviton Mfg. Company Inc.
    - d. Pass & Seymour/Legrand; Wiring Devices Div.

- 2. Occupancy Sensors:
  - a. Cooper Industries, Inc.
  - b. Hubbell Incorporated.
  - c. Leviton Mfg. Company, Inc.
  - d. Pass & Seymour/Legrand.
  - e. The Watt Stopper.
  
- 3. Poke-Through and Floor Service Outlets:
  - a. Hubbell Incorporated; Wiring Device-Kellems.
  - b. Pass & Seymour/Legrand; Wiring Devices Div.
  - c. Square D/Groupe Schneider NA.
  - d. Thomas & Betts Corporation.
  - e. Wiremold Company (The).

2.2 STRAIGHT BLADE RECEPTACLES

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498, and FS W-C-596.
  - 1. Description: Grounding system shall be all brass and integral to the wrap around mounting strap (single-piece with no rivets or mechanical connections in the primary path between the point of ground wire termination and ground blades). NOTE: specific catalog numbers are not listed below. This product description (or similar verbiage) must be highlighted in the submittal documents to confirm this performance requirement has been satisfied.

2.3 GFCI RECEPTACLES

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A.

2.4 WALL-BOX DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.
- C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.
  - 1. 600 W; dimmers shall require no derating when ganged with other devices. Illuminated when "OFF."

- D. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

## 2.5 OCCUPANCY SENSORS

### A. Wall-Switch Sensors:

- 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

### B. Wall-Switch Sensors:

- 1. Description: Adaptive-technology type, 120/277 V, adjustable time delay up to 20 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.

### C. Long-Range Wall-Switch Sensors:

- 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, with a minimum coverage area of 1200 sq. ft.

### D. Long-Range Wall-Switch Sensors:

- 1. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft.

### E. Wide-Range Wall-Switch Sensors:

- 1. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft.

### F. Exterior Occupancy Sensors:

- 1. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

## 2.6 WALL PLATES

### A. Single and combination types to match corresponding wiring devices.

- 1. Plate-Securing Screws: Metal with head color to match plate finish.
- 2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
- 3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
- 4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

### B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant, die-cast aluminum with lockable cover.



2.7 FLOOR SERVICE FITTINGS

- A. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- B. Compartments: Barrier separates power from voice and data communication cabling.
- C. Service Plate: Round, die-cast aluminum with satin finish.
- D. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 Category 5e jacks for UTP cable.

2.8 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service outlet assembly.
  - 1. Service Outlet Assembly: Pedestal type with services indicated or Flush type with two simplex receptacles and space for two RJ-45 jacks.
  - 2. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
  - 3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  - 4. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
  - 5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of two, 4-pair, Category 5e voice and data communication cables.

2.9 MULTIOULET ASSEMBLIES

- A. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- B. Raceway Material: Metal, with manufacturer's standard finish.
- C. Wire: No. 12 AWG.
- D. Number of Circuits: As indicated on drawings.

2.10 FINISHES

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices: Ivory or White or As selected by Architect, unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Wiring devices, on emergency power circuits, shall be red in color.
- B. All wall plates within a room or area shall be same type – thermoplastic. Mix matching of wall plates shall not be acceptable.

3.2 INSTALLATION

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
  - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:
  - 1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  - 2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  - 3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
  - 4. Existing Conductors:
    - a. Cut back and pigtail, or replace all damaged conductors.
    - b. Straighten conductors that remain and remove corrosion and foreign matter.
    - c. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
  - 1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  - 2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  - 3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  - 4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
10. Install devices and assemblies level, plumb and square with building lines.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles at top, and on horizontally mounted receptacles to the right.
2. Install ground pin of vertically mounted receptacles, located more than 60" above floor, at bottom.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

J. Install GFCI receptacles as shown on drawings and within 60 inches of water source.

### 3.3 IDENTIFICATION

A. Comply with Division 26 Section "Identification for Electrical Systems."

1. Receptacles and Switch Wall Plates: Identify panelboard and circuit number from which served. Use engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

### 3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Test Instruments: Use instruments that comply with UL 1436.

2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
1. Line Voltage: Acceptable range is 105 to 132 V.
  2. Percent Voltage Drop under 15-A Load: A value of 5 percent or higher is not acceptable.
  3. Ground Impedance: Values of up to 2 ohms are acceptable.
  4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  5. Using the test plug, verify that the device and its outlet box are securely mounted.
  6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

END OF SECTION 262726

SECTION 265100 - INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Interior lighting fixtures, LED modules, and drivers.
  - 2. Exit signs.
  - 3. Lighting fixture supports.
- B. Related Sections include the following:
  - 1. Division 26 Section "Lighting Control Devices".
  - 2. Division 26 Section "Wiring Devices".

1.3 DEFINITIONS

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. RCR: Room cavity ratio.

1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. LED driver.
  - 3. Energy-efficiency data.

4. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with LEDs and drivers identical to those indicated for the lighting fixture as applied in this Project.
  - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
  - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
  1. Lighting fixtures.
  2. Suspended ceiling components.
  3. Structural members to which suspension systems for lighting fixtures will be attached.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- E. Warranties: Special warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. 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.
- C. Comply with NFPA 70.

1.6 COORDINATION

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.7 WARRANTY

- A. Special Warranty for LED Drivers: Manufacturer's standard form in which drivers manufacturer agrees to repair or replace drivers that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Electronic Drivers: Five years from date of final acceptance by Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
  - 2. Troffers:
    - a. Columbia Lighting; Division of Hubbell Lighting.
    - b. H.E. Williams, Inc.
    - c. Lithonia Lighting.
    - d. LSI Midwest Lighting.
    - e. Metalux.
  - 3. Strip Fixtures:
    - a. Columbia Lighting; Division of Hubbell Lighting.
    - b. H.E. Williams, Inc.
    - c. Lithonia Lighting.
    - d. LSI Midwest Lighting.
    - e. Metalux.
  - 4. Under Cabinet Fixtures:
    - a. ALKCO; Division of JJI Lighting Group Co.
    - b. Columbia Lighting.
    - c. H.E. Williams, Inc.
    - d. Lithonia Lighting.
    - e. LSI Midwest Lighting.
    - f. Metalux.
    - g. Nulite Limited.

- 5. Exit Signs and Emergency Lighting:
  - a. Dual-Lite; Division of Hubbell Lighting.
  - b. Emergi-lite; Division of Thomas and Betts.
  - c. Failsafe; Division of Cooper Lighting.
  - d. H.E. Williams, Inc.
  - e. Hubbell Lighting, Inc.
  - f. Lithonia Lighting.
  - g. Prescolite; Division of Hubbell Lighting.
  - h. Surelite; division of Cooper Lighting.

- 6. Downlighting (Recessed, Surface, HID):
  - a. Edison Price Lighting.
  - b. Halo; Division of Cooper Lighting.
  - c. H.E. Williams, Inc.
  - d. Hubbell Lighting, Inc.
  - e. Infinity Lighting.
  - f. The Kirlin Company.
  - g. Kurt Versen Co.
  - h. Lithonia Lighting.
  - i. Lightolier; Division of Genlyte Thomas Co.
  - j. Prescolite; division of Hubbell Lighting.
  - k. Rambusch Lighting.

- C. In order to create a controlled, competitive bidding climate, the Lighting Fixture Schedule, as indicated on the drawings, was developed around the manufacturer listed in the schedule. Equal products from the manufacturers listed will be acceptable. In limited circumstances, for various reasons, certain fixtures were deemed to be proprietary. In these cases, the language, "No substitutions", is intended to provide the electrical distributors bidding the job with the ability to assemble the most competitive lump sum price for the lighting fixture/lamp package. The electrical distributor, therefore, has the authority to require unit pricing from the manufacturer's representatives for those products so specified.
- D. Light Fixture Schedule as indicated on drawings.

## 2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

- 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 inch minimum unless different thickness is indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.
  
- G. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on each ballast indicated to require a filter.

## 2.3 LED MODULES AND DRIVERS

- A. Comply with LM-79, LM-80 and TM-21 standards for the following:
  - 1. Color Rendering Index (CRI): Minimum 80.
  - 2. Color Corrected Temperature (CCT): As noted in Light Fixture Schedule.
  - 3. Lumen Output: As noted in Light Fixture Schedule.
  - 4. Lifetime: L70 minimum 50,000 hours.
  
- B. Dimming: Drivers shall be dimmable down to 1% standard, unless noted otherwise in Light Fixture Schedule, and flicker-free.
  
- C. Control Voltage: As noted in Light Fixture Schedule.
  - 1. Ballast Manufacturer Certification: Indicated by label.

## 2.4 EXIT SIGNS

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
  
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.

2.5 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- C. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- D. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gauge.
- E. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- F. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- G. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

2.6 DIMMING CONTROL DEVICES

- A. Dimming Controls: Sliding-handle type with on/off control; compatible with LED driver and having light output and energy input over the full dimming range.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least two independent support rods or wires 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 Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.

D. Adjust aimable lighting fixtures to provide required light intensities.

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".

3.2 FIELD QUALITY CONTROL

- A. 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.

END OF SECTION 265100

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SECTION 270500 - COMMON WORK RESULTS FOR COMMUNICATIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. MU Division of IT Telecommunications Construction Standards and Specifications apply to this section. The Contractor shall obtain the latest revision of document and install all cables, pathways, boxes, equipment, and hardware in a manner to conform with MU Standards and Specifications.

1.2 SUMMARY

- A. Section Includes:
  - 1. Communications equipment coordination and installation.
  - 2. Sleeves for pathways and cables.
  - 3. Grout.
  - 4. Common communications installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For pre-manufactured sleeves, and for sleeve seals.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of communications equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 3. To allow right of way for piping and conduit installed at required slope.
  - 4. So connecting pathways, cables, wireways and cable trays will be clear of obstructions and of the working and access space of other equipment.

- B. Coordinate installation of required supporting devices and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

1.6 SCHEDULING AND PHASING

- A. All Communications work shall be scheduled to meet project completion date. All work shall be phased for projects requiring phasing work. Install additional conduit, junction-boxes, pull-boxes, devices, cables as required to support phasing. Refer to phasing schedule on drawings.

PART 2 - PRODUCTS

2.1 SLEEVES FOR PATHWAYS AND CABLES

- A. Pre-manufactured fire-stop sleeves: STI EZ-Path Series 44. Provide in quantity to match cable fill capacity to fill capacity of adjacent cable tray, where tray path crosses fire- and/or smoke-rated walls.
- B. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- C. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

**2.3 COORDINATION DRAWINGS**

- A. The contractor shall prepare CAD generated drawings (min. ¼" scale) showing following systems/items as a minimum:
  - 1. Equipment locations and clearances required.
  - 2. Locations of items in ceilings such as lights, etc.
- B. The contractor shall submit the CAD generated drawings for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by the contractor.
- C. The contractor shall participate in coordination meetings when requested.

**2.4 PROJECT RECORD DRAWINGS**

- A. Drawings shall be furnished in electronic-media (CD-Rewritable type) and at-least one hard copy prints.
  - 1. Format: Same CAD program, version and operating system as the original contract documents.
  - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw and add details and notations where applicable.
- B. Identify and date each drawing and include the designation "PROJECT RECORD DRAWING" or "AS-BUILT DRAWING" in a prominent location, with contractor's name below it.

**PART 3 - EXECUTION**

**3.1 DEMOLITION**

- A. Refer to Division 02 Section "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove communication systems, fixtures, devices, and components indicated to be removed. In general, remove all fixtures, raceways, cables, junction boxes, and equipment not utilized in new construction. For devices disconnected, remove raceways and cables all way to the source.
- C. Protect existing communication equipment and installation indicated to remain. If damaged or disturbed in the course of the Work, remove damaged portions and install new products of equal capacity, quality, and functionality.
- D. Accessible Work: Remove exposed communication equipment and installations, indicated to be demolished, in their entirety.
- E. Remove demolished material from Project site.

- F. Remove, store, clean, reinstall, reconnect, and make operational components indicated for relocation.
- G. Remove equipment to be salvaged, disconnect from power, and deliver to Owner as directed.

**3.2 COMMON REQUIREMENTS FOR COMMUNICATIONS INSTALLATION**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both communications equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. In general install raceways and boxes minimum 8" above hung ceiling. All raceways, boxes and equipment shall be independently supported from structure. Do not support from ductwork or piping.
- G. Maintain following minimum clearances from J-hooks and all cable pathways, to avoid electromagnetic interference, from the following:
  - 1. Motors and transformers: 4-feet
  - 2. Conduit and cables used for electrical power distribution: 1-foot
  - 3. Fluorescent lighting: 5-inches

**3.3 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS**

- A. Communications penetrations occur when pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting to extend three inches past both surfaces of walls.
- F. Extend sleeves installed in floors four inches above finished floor level.



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- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and pathway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 270500

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SECTION 271500 - 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.
- B. MU Division of IT Telecommunications Construction Standards and Specifications apply to this section. The Contractor shall obtain the latest revision of document and install all cables, pathways, boxes, equipment, and hardware in a manner to conform with MU Standards and Specifications.

1.2 SUMMARY

A. Section Includes:

- 1. Pathways.
- 2. UTP cabling.
- 3. Coaxial cable.
- 4. Cabling system identification products.
- 5. Cable management system.

B. Related Sections:

- 1. Division 28 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

C. System Description:

- 1. The Owner will furnish, terminate, label, and test all telephone, data and television cable for installation by the Contractor. The Contractor shall install all Owner-provided horizontal cables in a manner acceptable to the Owner.
- 2. All backbone cabling and telephone, data and television distribution equipment will be furnished, installed, terminated, labeled, and tested by the Owner.
- 3. Equipment racks and overhead ladder runways in Telecom Rooms shall be furnished and installed by Owner. Owner will bond these items to Contractor-provided busbars within the Telecom Rooms.
- 4. All work shall be coordinated with the Owner.
- 5. Cabling shall be supported with cable tray and with J-hooks in accessible ceiling areas. Cable tray layout is shown on the plans, J-Hook methodology on the drawing details, and shall be furnished and installed by the Contractor. Install cabling in EMT conduit with capacity equaling adjacent cable tray in areas where ceilings are not accessible.

**1.3 DEFINITIONS**

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel.
- D. Consolidation Point: A location for interconnection between horizontal cables extending from building pathways and horizontal cables extending into furniture pathways.
- E. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.
- F. EMI: Electromagnetic interference.
- G. IDC: Insulation displacement connector.
- H. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- I. LAN: Local area network.
- J. MUTOA: Multiuser telecommunications outlet assembly, a grouping in one location of several telecommunications outlet/connectors.
- K. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.
- L. RCDD: Registered Communications Distribution Designer.
- M. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom without ventilation openings.
- N. Trough or Ventilated Cable Tray: A fabricated structure consisting of longitudinal side rails and a bottom having openings for the passage of air.
- O. UTP: Unshielded twisted pair.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
  - 1. J-hooks.
  - 2. Telecommunications Grounding busbars, conductors and bonding connectors.
- B. Qualification Data: For qualified layout technician and installation supervisor.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.
  - 1. Installation Supervision: Installation shall be under the direct supervision of a BICSI Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.
- B. All testing shall be performed by Owner. Contractor shall re-pull all cables that fail testing.
- 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. Telecommunications Pathways and Spaces: Comply with ANSI/TIA-569-B.
- E. Grounding: Comply with ANSI-J-STD-607-A.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. The Owner will deliver all cables to the job site. The Contractor shall store cables to prevent entrance of dirt, debris and moisture.
- B. Protect stored cables from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.8 COORDINATION

- A. Coordinate layout and installation of telecommunications pathways and 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.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. Cable Support: NRTL labeled for support of Category 6A cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. J-hooks with fastening devices to maintain cable bundles within j-hooks.
  - 2. J-hooks shall be plenum rated, and as manufactured by B-Line, Erico/Caddy, or Panduit.
  - 3. J-hooks shall be sized to allow for minimum 40% spare cable capacity, with a minimum support diameter of 2 inches.
  - 4. Cable bundles in J-hooks shall not exceed fifty (50) cables.
- B. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
  - 1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep, with plaster ring to accommodate a 2 inch by 4 inch faceplate, unless noted otherwise on the plans.
  - 2. Conduit stub-ups from outlet boxes to above accessible ceiling, shall be 1 inch diameter minimum, shall turn 90-degrees at a minimum 12" above ceiling, and shall be reamed and have insulated bushings installed to avoid cable damage.

2.2 GROUNDING

- A. Comply with requirements per drawing notes and details, and in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.
- B. Bonding connectors shall be 2-hole irreversible compression type, as manufactured by Panduit or Burndy.
- C. Comply with ANSI-J-STD-607-A.

PART 3 - EXECUTION

3.1 CABLE INSTALLATION REQUIREMENTS

- A. Install voice, data and television cable as supplied by the Owner.
- B. Furnish all required installation tools to facilitate cable pulling without damage to cable jacket.
- C. During pulling operation adequate number of workers shall be present to allow cable observation at all points of raceway entry and exit, as well as to feed cable and operate pulling machinery.

- D. Pull cables in accordance with cable manufacturer's recommendations and ANSI/IEEE C2 Standards. Recommended pulling tensions and pulling bending radius shall not be exceeded. Any cables bent or kinked to radius less than recommended dimension are not allowed and shall be replaced at no expense to Owner.
  - 1. Category 6A cables shall be installed with minimum bend radius of six times the outside cable diameter.
- E. Pull all cable by hand unless installation conditions require mechanical assistance. Where mechanical assistance is used, care shall be taken to insure that maximum tensile load for cable as defined by these specifications is not exceeded. This may be in the form of continuous monitoring of pulling tension, use of "break-away" or other approved method.
- F. Install cable in conduit cable trays or J-hooks in accessible ceiling areas. Anchor all cable supports independently to building structure. All routing shall be kept clear of other trades' work. D-rings and bridal rings are not acceptable.
- G. J-hook cable supports shall be installed in accordance with manufacturers' installation requirements. Spacing of J-hook cable supports shall be maximum every 5 ft. or in accordance with cable manufacturers' specifications, whichever distance is shorter.
- H. Size all cable pathways to allow for minimum 40% spare cable fill capacity.
  - 1. Maximum number of Category 6A cables allowed to be installed in conduit according to conduit trade sizes shall be as follows:
    - a. 1" Conduit: 3 cables
    - b. 1-1/4" Conduit: 4 cables
    - c. 1-1/2" Conduit: 6 cables
    - d. 2" Conduit: 12 cables
    - e. 3" Conduit: 20 cables
- I. Cable bundles in j-hooks shall not exceed a maximum of 50 cables.
- J. Eliminate cable stress caused by tension in suspended cable runs. Cables must exhibit some sag in hanging between supports.
- K. Cable routing in telecom closet shall be routed and supported on Owner-furnished Owner-installed ladder runway. Coordinate installation and lengths required with the Owner as required for the Owner to land cables on the equipment furnished and installed by them. Provide minimum 10-feet of slack past termination location in every cable in Telecom Room, based on coordination with Owner, per requirements in the UMC Division of IT Telecommunications Construction Standards and Specifications.
- L. Provide minimum 12-inches of cable slack in outlet back-boxes, and 3-feet of cable slack in service loop above each outlet conduit stub-up.
- M. Contractor shall be responsible for identifying and reporting to Construction Manager any existing damage to walls, flooring, tiles and furnishings in work area prior to start of work. Repair damage to interior spaces caused by installation of cable, raceway or other hardware. Repairs must match pre-existing color and finish of walls, floors and ceilings. Replace any contractor-damaged ceiling tiles to match color, size, style and texture.

- N. Avoid abrasion and other damage to cables during installation.
- O. Pulling lubricant may be used to ease pulling tensions. Lubricant shall be of type that is non-injurious to cable jacket and other materials used. Lubricant shall not harden or become adhesive with age.
- P. Provide pull cord (200 lb. minimum) installed with cable installed in each conduit 1¼" and larger.
- Q. Provide to Engineer, prior to installation, submittals drawings showing proposed installation for approval.
- R. Install cables with no splices unless otherwise specified. Damaged or broken cables must be completely replaced at no additional cost to Owner.
- S. Cabling shall be neatly laced, dressed, and supported. Plenum-rated cable ties shall be utilized in plenum spaces. Velcro-type cable ties shall be utilized in Telecom Rooms, on maximum spacing of 36" between ties. Cable ties shall be hand-applied, never applied with a tool, and shall remain loose around cable bundles such that the ties can be rotated by hand after installation.
- T. Grounding and Bonding:
  - 1. Contractor to coordinate system grounding and bonding requirements where provided.
  - 2. Comply with Division 26 Section "Grounding and Bonding for Electrical Systems."
  - 3. Install bonding connectors on conductors via manufacturer-approved irreversible compression tool.
- U. Voice and data system cables shall be placed within cable trays where shown on floor plans, and in J-hooks where cables are not in cable trays and are above accessible ceilings. Support J-hooks on maximum 60-inch spans, from wall or structure above accessible ceilings. Furnish and install all-thread, Unistrut or other support structure as required to support J-hooks and cables.
- V. Maintain 8" minimum clearance from bottom of J-hooks to ceilings.
- W. Maintain following minimum clearances from J-hooks and all cable pathways, to avoid electromagnetic interference, from the following:
  - 1. Motors and transformers: 4-feet
  - 2. Conduit and cables used for electrical power distribution: 1-foot
  - 3. Fluorescent lighting: 5-inches
- X. Cable pathways shall be installed in such a way as to facilitate ongoing maintenance, additions, and relocations.
- Y. All pathway devices and support hardware shall have smooth edges, with no sharp edges coming in contact with cables.
- Z. Pathways and cabling shall be installed such that no Communications cable length exceeds 295-feet total from Telecom Room termination location to outlet termination location.
- AA. Cable routing, support, and sealing of penetrations shall meet applicable MU codes.



3.2 TESTING

- A. Owner shall be responsible for cable testing and qualified personnel to conduct acceptance tests.
- B. If Owners' tests fail to meet industry specifications, the Contractor shall replace and make changes as are necessary and then Owner will repeat tests, which disclose fault or defective material, equipment or installation method. Provide labor and materials at no additional cost to Owner.

END OF SECTION 271500

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SECTION 280500 - COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Electronic safety and security equipment coordination and installation.
  - 2. Sleeves for raceways and cables.
  - 3. Grout.
  - 4. Coordination drawings.
  - 5. Project record drawings.
  - 6. Electronic safety and security demolition.
  - 7. Common electronic safety and security installation requirements.

1.3 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For sleeve seals.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery raceways in clean condition. Store to prevent entrance of dirt, debris and moisture.
- B. Protect stored raceways, cables, and connectors from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor, if stored inside.

1.6 COORDINATION

- A. Coordinate arrangement, mounting, and support of electronic safety and security equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.

2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  3. To allow right of way for piping and conduit installed at required slope.
  4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electronic safety and security items that are behind finished surfaces or otherwise concealed.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

#### 1.7 SCHEDULING AND PHASING

- A. All electronic safety and security work shall be scheduled to meet project completion date. All work shall be phased for projects requiring phasing of work. Install additional conduit, junction-boxes, pull-boxes, devices as required to support phasing. Refer to phasing schedule on drawings.

### PART 2 - PRODUCTS

#### 2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

#### 2.2 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.3 COORDINATION DRAWINGS

- A. The contractor shall prepare CAD generated drawings (min. 1/4" scale) showing following systems/items as a minimum:
  - 1. Main equipment locations and clearances required.
  - 2. Locations of items in ceiling such as cameras, smoke detectors, heat detectors, etc.
- B. The contractor shall submit the CAD generated drawings to the contractor for coordination with other trades. The drawings shall be submitted either in electronic format or printed copies as requested by the contractor.
- C. The contractor shall participate in coordination meetings when requested by the contractor.

2.4 PROJECT RECORD DRAWINGS

- A. Drawings shall be furnished in electronic-media (CD-Rewritable type) and at-least one hard copy prints.
  - 1. Format: Same CAD program, version and operating system as the original contract documents.
  - 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw and add details and notations where applicable.
- B. Identify and date each drawing and include the designation "PROJECT RECORD DRAWING" or "AS-BUILT DRAWING" in a prominent location, with contractor's name below it.

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRONIC SAFETY AND SECURITY INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electronic safety and security equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRONIC SAFETY AND SECURITY PENETRATIONS

- A. Electronic safety and security penetrations occur when raceways, pathways, cables, wireways, or cable trays penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.3 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electronic safety and security installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 280500

SECTION 280513 - CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. UTP cabling.
  - 2. 50/125-micrometer, multimode optical fiber cabling.
  - 3. Coaxial cabling.
  - 4. RS-232 cabling.
  - 5. RS-485 cabling.
  - 6. Low-voltage control cabling.
  - 7. Control-circuit conductors.
  - 8. Fire alarm wire and cable.
  - 9. Identification products.
- B. All fire alarm system wiring shall be installed in a dedicated raceway. Raceway may be EMT, RMC, FMC and LFMC (flexible type limited by NEC).

1.3 DEFINITIONS

- A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.
- B. BICSI: Building Industry Consulting Service International.
- C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel section.
- D. EMI: Electromagnetic interference.
- E. IDC: Insulation displacement connector.
- F. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).
- G. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- H. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

- I. RCDD: Registered Communications Distribution Designer.
- J. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal side rails, and a bottom without ventilation openings.
- K. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.
- L. UTP: Unshielded twisted pair.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
  - 1. For fire alarm wiring and cable, include the following installation data for each type used:
    - a. Nominal OD.
    - b. Minimum bending radius.
    - c. Maximum pulling tension.
- B. Shop Drawings: Cable tray layout, showing cable tray route to scale, with relationship between the tray and adjacent structural, electrical, and mechanical elements. Include the following:
  - 1. Vertical and horizontal offsets and transitions.
  - 2. Clearances for access above and to side of cable trays.
  - 3. Vertical elevation of cable trays above the floor or bottom of ceiling structure.
  - 4. Load calculations to show dead and live loads as not exceeding manufacturer's rating for tray and its support elements.
- C. Qualification Data: For qualified layout technician, installation supervisor, and field inspector.
- D. Field quality-control reports.
- E. Maintenance Data: For wire and cable to include in maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: 25 or less.
  - 2. Smoke-Developed Index: 50 or less.
- 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.



1.6 DELIVERY, STORAGE, AND HANDLING

- A. Test cables upon receipt at Project site.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install UTP, optical fiber, and coaxial cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 PATHWAYS

- A. All fire alarm system wiring shall be installed in a dedicated raceway. Raceway may be EMT, RMC, FMC, LFMC (flexible type limited by NEC), and surface raceway (only in areas where not subject to damage).
- B. Support of Open Cabling: NRTL labeled for support of Category 5e/Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.
  - 1. Support brackets with cable tie slots for fastening cable ties to brackets.
  - 2. Lacing bars, spools, J-hooks, and D-rings.
  - 3. Straps and other devices.
- C. Cable Trays:
  - 1. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Cable Management Solutions, Inc.
    - b. Cablofil Inc.
    - c. Chalfant Manufacturing Co.
    - d. Cooper B-Line, Inc.
    - e. Cope - Tyco/Allied Tube & Conduit.
    - f. GS Metals Corp.
    - g. MONO-SYSTEMS, Inc.
    - h. MP Husky.
    - i. FW Industries.
  - 2. Cable Tray Materials: Metal, suitable for indoors, and protected against corrosion by electroplated zinc galvanizing, complying with ASTM B 633, Type 1, not less than 0.000472 inch.
    - a. Basket Cable Trays: 6 inches wide and 2 inches. Wire mesh spacing shall not exceed 2 by 4 inches.
    - b. Trough Cable Trays: Nominally 6 inches wide.

- c. Ladder Cable Trays: Nominally 18 inches wide, and a rung spacing of 12 inches.
  - d. Channel Cable Trays: One-piece construction, nominally 4 inches wide. Slot spacing shall not exceed 4-1/2 inches o.c.
  - e. Solid-Bottom Cable Trays: One-piece construction, nominally 12 inches wide. Provide without solid covers.
- D. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." Flexible metal conduit shall not be used.
- 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.

## 2.2 BACKBOARDS

- A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Division 06 Section "Rough Carpentry".

## 2.3 UTP CABLE

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Belden CDT Inc.; Electronics Division.
  - 2. Berk-Tek; a Nexans company.
  - 3. Genesis Cable Products; Honeywell International, Inc.
  - 4. KRONE Incorporated.
  - 5. Mohawk; a division of Belden CDT.
  - 6. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 7. Superior Essex Inc.
  - 8. 3M.
  - 9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: 100-ohm, 4-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 5e or Category 6.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:
    - a. Communications, General Purpose: Type CM or CMG.
    - b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    - c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    - d. Communications, Limited Purpose: Type CMX.
    - e. Multipurpose: Type MP or MPG.
    - f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    - g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Technology Systems Industries, Inc.
  - 2. Hubbell Premise Wiring.
  - 3. KRONE Incorporated.
  - 4. Leviton Voice & Data Division.
  - 5. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 6. Panduit Corp.
  - 7. Siemon Co. (The).
  - 8. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. UTP Cable Connecting Hardware: IDC type, using modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of the same category or higher.
- C. Connecting Blocks: 110-style for Category 5e/110-style for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

2.5 OPTICAL FIBER CABLE

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Berk-Tek; a Nexans company.
  - 2. Corning Cable Systems.
  - 3. General Cable Technologies Corporation.
  - 4. Mohawk; a division of Belden CDT.
  - 5. Nordex/CDT; a subsidiary of Cable Design Technologies.
  - 6. Optical Connectivity Solutions Division; Emerson Network Power.
  - 7. Superior Essex Inc.
  - 8. 3M.
  - 9. Tyco Electronics/AMP Netconnect; Tyco International Ltd.
- B. Description: Multimode, 50/125-micrometer, 24-fiber, nonconductive, tight buffer, optical fiber cable.
  - 1. Comply with ICEA S-83-596 for mechanical properties.
  - 2. Comply with TIA/EIA-568-B.3 for performance specifications.
  - 3. Comply with TIA/EIA-492AAAA-B for detailed specifications.
  - 4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444, UL 1651, and NFPA 70 for the following types:
    - a. General Purpose, Nonconductive: Type OFN or OFNG.
    - b. Plenum Rated, Nonconductive: Type OFNP, complying with NFPA 262.
    - c. Riser Rated, Nonconductive: Type OFNR, complying with UL 1666.
    - d. General Purpose, Conductive: Type OFC or OFCG.
    - e. Plenum Rated, Conductive: Type OFCP, complying with NFPA 262.
    - f. Riser Rated, Conductive: Type OFCR, complying with UL 1666.

5. Conductive cable shall be steel armored type.
6. Maximum Attenuation: 3.50 dB/km at 850 nm; 1.5 dB/km at 1300 nm.
7. Minimum Modal Bandwidth: 160 MHz-km at 850 nm; 500 MHz-km at 1300 nm.

C. Jacket:

1. Jacket Color: Aqua for 50/125-micrometer cable.
2. Cable cordage jacket, fiber, unit, and group color shall be according to TIA/EIA-598-B.
3. Imprinted with fiber count, fiber type, and aggregate length at regular intervals not to exceed 40 inches.

2.6 OPTICAL FIBER CABLE HARDWARE

A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Berk-Tek; a Nexans company.
4. Corning Cable Systems.
5. Hubbell Premise Wiring.
6. Nordex/CDT; a subsidiary of Cable Design Technologies.
7. Optical Connectivity Solutions Division; Emerson Network Power.
8. Siemon Co. (The).

B. Cable Connecting Hardware: Meet the Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA-568-B.3.

1. Quick-connect, simplex and duplex, Type SC/Type ST connectors. Insertion loss not more than 0.75 dB.
2. Type SFF connectors may be used in termination racks, panels, and equipment packages.

2.7 RS-232 CABLE

A. Standard Cable: NFPA 70, Type CM.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Polypropylene insulation.
3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. PVC jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Plastic insulation.

3. Individual aluminum foil-polyester tape shielded pairs with 100 percent shield coverage.
4. Plastic jacket.
5. Pairs are cabled on common axis with No. 24 AWG, stranded (7x32) tinned copper drain wire.
6. Flame Resistance: Comply with NFPA 262.

2.8 RS-485 CABLE

A. Standard Cable: NFPA 70, Type CM or CMG.

1. Paired, 2 pairs, twisted, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated Cable: NFPA 70, Type CMP.

1. Paired, 2 pairs, No. 22 AWG, stranded (7x30) tinned copper conductors.
2. Fluorinated ethylene propylene insulation.
3. Unshielded.
4. Fluorinated ethylene propylene jacket.
5. Flame Resistance: NFPA 262, Flame Test.

2.9 LOW-VOLTAGE CONTROL CABLE

A. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

B. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.

1. 1 pair, twisted, No. 16 AWG, stranded (19x29) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

C. Paired Lock Cable: NFPA 70, Type CMG.

1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1581.

- D. Plenum-Rated, Paired Lock Cable: NFPA 70, Type CMP.
  - 1. 1 pair, twisted, No. 18 AWG, stranded (19x30) tinned copper conductors.
  - 2. Fluorinated ethylene propylene insulation.
  - 3. Unshielded.
  - 4. Plastic jacket.
  - 5. Flame Resistance: NFPA 262, Flame Test.

2.10 CONTROL-CIRCUIT CONDUCTORS

- A. Class 1 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- B. Class 2 Control Circuits: Stranded copper, Type THHN-THWN, in raceway complying with UL 83.
- C. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type TW or TF, complying with UL 83.

2.11 FIRE ALARM WIRE AND CABLE

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Comtran Corp.
  - 2. Genesis Cable Products; Honeywell International, Inc.
  - 3. Rockbestos-Suprenant Cable Corporation.
  - 4. West Penn Wire/CDT; a division of Cable Design Technologies.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.
- C. Wiring shall be U.L. listed as fire alarm protection signaling circuit cable per NEC. Wire for notification circuits shall be a minimum #14 AWG, type KF-2 or KFF-2. Cable type may vary if recommended by the system manufacturer for compatibility with system warranty or design.

2.12 IDENTIFICATION PRODUCTS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Brady Corporation
  - 2. HellermannTyton.
  - 3. Kroy LLC.
  - 4. Panduit Corp.
- B. Comply with UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

- C. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.13 SOURCE QUALITY CONTROL

- A. Factory test UTP and optical fiber cables on reels according to TIA/EIA-568-B.1.
- B. Factory test UTP cables according to TIA/EIA-568-B.2.
- C. Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-B.3.
- D. Factory sweep test coaxial cables at frequencies from 5 MHz to 1 GHz. Sweep test shall test the frequency response, or attenuation over frequency, of a cable by generating a voltage whose frequency is varied through the specified frequency range and graphing the results.
- E. Cable will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 INSTALLATION OF PATHWAYS

- A. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.
- B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.
- C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems." for installation of conduits and wireways.
- D. Install manufactured conduit sweeps and long-radius elbows whenever possible.
- E. Pathway Installation in Equipment Rooms:
  - 1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room.
  - 2. Install cable trays to route cables if conduits cannot be located in these positions.
  - 3. Secure conduits to backboard when entering room from overhead.
  - 4. Extend conduits 3 inches above finished floor.
  - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- F. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly, and form smooth gap-free corners and joints.

3.2 INSTALLATION OF CONDUCTORS AND 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. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
  - 5. 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.
  - 6. 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.
  - 7. 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.
  - 8. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.
  - 9. 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. Optical Fiber Cable Installation:
  - 1. Comply with TIA/EIA-568-B.3.
  - 2. Cable shall be terminated on connecting hardware that is rack or cabinet mounted.
- E. Open-Cable Installation:
  - 1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
  - 2. Suspend copper 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.
- F. Installation of Cable Routed Exposed under Raised Floors:
  - 1. Install plenum-rated cable only.
  - 2. Install cabling after the flooring system has been installed in raised floor areas.
  - 3. Coil cable 72 inches long shall be neatly coiled not less than 12 inches in diameter below each feed point.



G. Outdoor Coaxial Cable Installation:

1. Install outdoor connections in enclosures complying with NEMA 250, Type 4X. Install corrosion-resistant connectors with properly designed O-rings to keep out moisture.
2. Attach antenna lead-in cable to support structure at intervals not exceeding 36 inches.

H. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A recommendations 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 Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.
6. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.3 FIRE ALARM WIRING INSTALLATION

- A. Comply with NECA 1 and NFPA 72.
- B. Wiring Method: Install wiring in metal raceway according to Division 26 Section "Raceway and Boxes for Electrical Systems."
  1. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated raceway system. This system shall not be used for any other wire or cable.

- C. Wiring Method:
  - 1. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
- D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.
- F. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.
- G. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.
- H. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

### 3.4 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:
  - 1. Class 1 remote-control and signal circuits, No. 14 AWG.
  - 2. Class 2 low-energy, remote-control and signal circuits, No. 16 AWG.
  - 3. Class 3 low-energy, remote-control, alarm and signal circuits, No. 12 AWG.

### 3.5 FIRESTOPPING

- A. Comply with requirements in Division 07 Section "Penetration Firestopping."
- B. Comply with TIA/EIA-569-A, "Firestopping" Annex A.
- C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.6 GROUNDING

- A. For communications wiring, comply with ANSI-J-STD-607-A and with BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.
- B. For low-voltage wiring and cabling, comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems."

3.7 IDENTIFICATION

- A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Tests and Inspections:
  - 1. Visually inspect UTP and optical fiber cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments, and inspect cabling connections to confirm compliance with TIA/EIA-568-B.1.
  - 2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
  - 3. Test UTP 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.
  - 4. Optical Fiber Cable Tests:
    - a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.1. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
    - b. Link End-to-End Attenuation Tests:
      - 1) Multimode Link Measurements: Test at 850 or 1300 nm in 1 direction according to TIA/EIA-526-14-A, Method B, One Reference Jumper.
      - 2) Attenuation test results for links shall be less than 2.0 dB. Attenuation test results shall be less than that calculated according to equation in TIA/EIA-568-B.1.

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- C. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- D. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 280513

SECTION 283111 - DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

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. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Magnetic door holders.
7. Remote annunciator.
8. Addressable interface device.
9. Digital alarm communicator transmitter.
10. System printer.

- B. All devices, equipment and installation are to be provided by a single source who assumes responsibility for the entire system per NFPA 72. Non-addressable devices do not have to be of the same brand as the main system, but must meet the manufacturer's requirements and UL ratings for the system installed.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.4 SYSTEM DESCRIPTION

- A. Noncoded, UL-certified addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Fire-alarm control unit and raceways shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event".

1.6 SUBMITTALS

- A. 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.
- B. Product Data: For each type of product indicated.
- C. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
  - 2. Current draw on each notification circuit with allowance for 20% expansion.
  - 3. Include voltage drop calculations for all notification appliance circuits.
  - 4. Include battery-size calculations for entire system including any power expanders.
  - 5. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  - 6. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
  - 7. Include floor plans to indicate all final outlet locations showing address of each addressable device. Show size and route of cable and conduits.
  - 8. Include a matrix showing alarm and initiation devices with associated actions.
  - 9. Power Calculations:
    - a. Battery Capacity Calculations: Battery size shall be a minimum of 125% of the calculated requirement. Batteries must be capable of operating the panel in normal mode for 24 hours with sufficient capacity to operate the panel in alarm mode for 15 minutes at the end of that 24 hour period.
    - b. Supervisory power requirements for all equipment.

- c. Alarm power requirements for all equipment.
    - d. Power supply rating justification showing power requirements for each of the system power supplies. Power supplies shall be sized to furnish the total connected load in a worst-case condition.
  - 10. Complete manufacturer's catalog data on all devices, modules, bases, etc.
  - 11. Submit panel and annunciator panel configuration showing layout including the following as applicable:
    - a. Circuit interface panels including all modules.
    - b. Power supplies, batteries and battery chargers.
    - c. Pre-amplifiers, and tone generators.
    - d. Equipment enclosures.
    - e. Alarm monitoring modules, and supervised control modules.
    - f. Initiation loop must be capable of supporting at least 60 devices of any type. If the loop supports different numbers of different type devices, it must be capable of supporting at least 60 devices of each type.
    - g. Alarm notification circuits must be capable of 1.5 amps per circuit at 24vdc. Panels capable of allowing varying current draws per circuit, but allowing an average of 1.5 amps average may be allowed if the engineer designs the circuits appropriately. In that case each circuit must still have .3 amp minimum allowed for future in addition to the designed load.
  - 12. The latest version of software for programming the fire alarm system. A programming manual shall accompany the submitted program and shall be adequate to allow understanding, operation and editing by the system.
- D. Qualification Data: For qualified Installer.
- E. Proposed vendors must be able to show the ability to respond to requests for service within 24 hours and the ability to supply replacement parts for the system within 48 hours relative to the site where the system is to be installed.
- F. Seismic Qualification Certificates: For fire-alarm control unit, accessories, and components, from manufacturer.
- 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
  - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- G. Field quality-control reports.
- H. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
- 1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
  - 2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.

3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:
  - a. Frequency of testing of installed components.
  - b. Frequency of inspection of installed components.
  - c. Requirements and recommendations related to results of maintenance.
  - d. Manufacturer's user training manuals.
5. Manufacturer's required maintenance related to system warranty requirements.
6. Abbreviated operating instructions for mounting at fire-alarm control unit.
7. Copy of NFPA 72.

I. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III technician.
- C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.8 PROJECT CONDITIONS

- A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  1. Notify Architect no fewer than seven (7) days in advance of proposed interruption of fire-alarm service.
  2. Do not proceed with interruption of fire-alarm service without Architect's written permission.



1.9 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning with final acceptance by Owner, provide software support for two years.
- C. Upgrade Service: Update software to latest version at Project completion. Install and program software upgrades that become available within two years from date of final acceptance by Owner. Upgrading software shall include operating system. Upgrade shall include new or revised licenses for use of software.
  - 1. Provide 30 days' notice to Owner to allow scheduling and access to system and to allow Owner to upgrade computer equipment if necessary.

1.10 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than 1 unit.
  - 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than 1 unit of each type.
  - 4. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but no fewer than 1 unit of each type.
  - 5. Keys and Tools: One extra set for access to locked and tamper-proofed components.
  - 6. Audible and Visual Notification Appliances: One of each type installed.
  - 7. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products which coordinate with existing system.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices:
  - 1. Manual stations.
  - 2. Heat detectors.
  - 3. Flame detectors.
  - 4. Smoke detectors.
  - 5. Verified automatic alarm operation of smoke detectors.

6. Automatic sprinkler system water flow.
7. Heat detectors in elevator shaft and pit.
8. Fire-extinguishing system operation.
9. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators where indicated.
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. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Record events in the system memory.
10. Record events by the system printer.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.
4. Duct smoke detectors.
5. Fire pump power failure, phase reversal, and fire pump running.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.
4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal ac voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer.

## 2.3 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.
  - a. Provide multiple levels of detection sensitivity for each sensor.
7. Any initiating device installed above a suspended ceiling shall have an indicator showing below the ceiling the location of the device.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
  - a. Primary status.
  - b. Device type.
  - c. Present average value.
  - d. Present sensitivity selected.
  - e. Sensor range (normal, dirty, etc.).

2.4 NOTIFICATION APPLIANCES

- A. General Requirements for Notification Appliances: Individually addressed, connected to a signaling line circuit, equipped for mounting as indicated and with screw terminals for system connections.
- B. 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.
- C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.

2.5 ADDRESSABLE INTERFACE DEVICE

- A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- B. Integral Relay: Capable of providing a direct signal to elevator controller to initiate elevator recall.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Smoke- or Heat-Detector Spacing:
  - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
  - 2. Comply with NFPA 72, "Heat-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, 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 Appendix A in NFPA 72.
  - 5. HVAC: Locate detectors not closer than 3 feet 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.
- C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.
- D. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.
- E. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.
- F. Visible Alarm-Indicating Devices: Install adjacent to each alarm speaker and at least 6 inches below the ceiling.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

- A. Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Smoke dampers in air ducts of designated air-conditioning duct systems.
  - 2. Alarm-initiating connection to elevator recall system and components.

3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.4 GROUNDING

- A. Ground fire alarm equipment, conductors, and cable shields per NFPA and manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
  1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- D. Tests and Inspections:
  1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
    - b. Comply with "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 "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 of Fire Alarm Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
- E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- F. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.
- H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- I. Annual Test and Inspection: One year after date of final acceptance by Owner, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

**3.6 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111