

# **PROJECT MANUAL**

## **Ohio Museum Complex HVAC Improvements Lin Hall, Ohio University Athens, Ohio 45701**

**PREPARED FOR:**

**Athens County Commissioners  
Athens, Ohio 45701**

**PREPARED BY:**

**BDT Architects and Designers  
26 East Park Drive, Suite 101  
Athens, Ohio 45701  
Telephone: 740.592.2420**

**REBID 09/09/2024**

**INVITATION TO BIDDERS**

Sealed Bids will be received by Athens County Commissioners, at the Commissioner's office, 15 South Court Street, Athens, Ohio 45701 until **Tuesday, November 5, 2024, at 11:15 a.m.** local time, for the following project:

**Ohio Museum Complex HVAC Improvements  
Lin Hall, Ohio University  
Athens, Ohio 45701**

Sealed Bids will be received for a general contract for all material, labor and services as described in the Drawings and Specifications. Bids will be opened publicly at a date and time determined by the owner. All bids must be accompanied by a bid guaranty as noted in the project specifications.

A pre-bid meeting is scheduled for **10/23/2024 at 10:00am** at Lin Hall. Meet at the main building entrance. All bidders are encouraged to attend this opportunity to inspect the area of work.

Drawings and Specifications prepared by:

BDT Architects and Interior Designers (BDTAID, Inc.)  
26 E. Park Drive, Suite 101  
Athens, Ohio 45701  
Telephone: 740.592.2420

The project is for building renovations to Lin Hall at The Ridges including Abatement, General Trades, HVAC, Plumbing, Electric, Fire Alarm, Fire Sprinkler and Site Work.

Estimate of Probable Cost for total project is: \$1,700,000.00

Bidders may obtain hard copies of complete sets of the Bidding Documents from the Architect for a non-refundable charge of \$150.00 per set. An electronic set of the Bidding Documents can be emailed to bidders at no charge.

END OF INVITATION TO BIDDERS

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## INSTRUCTIONS TO BIDDERS

### 1. BIDDING DOCUMENTS

- A. Bidders may obtain hard copies of complete sets of the Bidding Documents from the Architect. \$150 non-refundable charge for hard copies of the bidding sets; no charge for emailed pdf file of bidding sets. A copy of the bidding set can be examined at the Architects office.
- B. All Bidders shall use complete sets of Bidding Documents in preparing their bids; neither the Owner nor the Architect assume any responsibility for misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- C. Bidders are responsible for sending bidding addendums to their vendors and subcontractors.

### 2. NOT USED

### 3. EXAMINATION AND INTERPRETATION OF DOCUMENTS DURING BIDDING

- A. The Bidder has the responsibility of examining the documents, the site, and the local conditions, and shall promptly notify the Architect of any ambiguity, inconsistency or error which they may discover.
- B. Site verification, except for the pre-bid conference will require an appointment. The existing structure is occupied.
- C. Bidders requiring clarification or interpretation of the Bidding Documents shall make a request which shall be received by the Architect at least four days prior to the date for receipt of Bids. Every request for such interpretation should be in in an email to Don Dispenza at [ddispenza@bdtaid.com](mailto:ddispenza@bdtaid.com).
- D. Any interpretation, correction or change of the Bidding Documents will be made by Addendum. Interpretation, correction or change of the Bidding Documents made in any other manner will not be binding, and Bidders shall not rely upon such interpretations, corrections and changes.
- E. If, in examining the Bidding Documents, the Bidder discovers an apparent violation of the Ohio Building Code or other applicable statute or regulation, he shall report such apparent violation to the Architect promptly. However, this provision shall not be construed as imposing responsibility on the Contractor to insure conformity of the Plans and Specifications to the Ohio Building Code and other applicable regulations.

### 4. ADDENDA

- A. Addenda will be emailed to all who are registered with the Architect to have received a complete set of Bidding Documents. Addenda will be made available for inspection wherever Bidding Documents are on file for that purpose.
- B. Addenda will be issued no later than 3 working days prior to the time for receipt of Bids, except an Addendum which includes a postponement of the date for receipt of Bids or withdrawing the request for Bids.
- C. Bidder shall acknowledge the receipt of all Addenda issued on his/her Bid Proposal. All addenda so issued shall become part of the Contract Documents.

### 5. STANDARDS AND SUBSTITUTIONS

- A. Whenever a material, article or piece of equipment is identified in the contract documents by reference to

manufacturer' or vendors' names, trade names, catalogue numbers, etc., it is intended merely to establish a standard. Any material, article, or equipment of other manufacturers and vendors that will perform adequately the duties imposed by general design will be considered equally acceptable provided the material, article, or equipment so proposed is, in the option of the Architect, of equal substance and function. However, such substitution material, article, or equipment shall not be purchased or installed by the contractor without the Architect's written approval.

- B. No substitution will be considered prior to receipt of Bids unless written request for approval has been received by the Architect at least 72 hours prior to the date for receipt of Bids. Each such request shall include the name of the material or equipment for which it is to be substituted and a complete description of the proposed substitute including drawings, cuts, performance and test data and any other information necessary for an evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute would require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution shall be final.
- C. If the Architect approves any proposed substitution prior to receipt of Bids, such approval will be set forth in an Addendum. Any request made within 72 hours of the bid will require an extended bid opening approved by the owner and the Architect. Bidders shall not rely upon approvals made in any other manner.
- D. No substitutions will be considered after the Contract award unless specifically provided in the Contract Documents.

#### 6. BASIS OF BIDS

- A. Project will be constructed under one general contract.

#### 7. PREPARATION OF BID

- A. One copy of each Bid must be submitted on the prescribed form. All blank spaces for bid prices must be filled in, in ink or typewritten. Each bid must be submitted in a sealed envelope bearing on the outside the name of the bidder, address of the bidder, the name of the project, and, if applicable, the Items of Work for which the bid is submitted. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in the bid form. The Proposal shall contain the following documents:
  - 1. The Form of Proposal
  - 2. The Bid Bond
- B. The wording of the Proposal shall be used without change, alteration, or addition. Any change in the wording will cause a Proposal to be rejected as not complying with bidding requirements.
- C. No Contract shall be entered into until Contract and Bond are submitted to the Owner's Legal Authority and approval is certified thereon.

#### 8. RECEIPT AND OPENING OF BIDS

- A. Bids shall be received at the designated location prior to the time and date for receipt of Bids indicated in the Bid Invitation, or any extension made by Addendum.
- B. Unless stated otherwise in the Invitation to Bid, the Bids received on time will be opened publically and read aloud.

- C. The Owner shall have the right to reject any or all Bids and to reject a Bid not accompanied by any required bid security or by other data required by the Bidding Documents, or to reject a Bid which is in any way incomplete or irregular.
- D. No Bidder may withdraw a bid within 60 days after the actual date of the opening thereof. Acceptance of the Contract within the 60-day period automatically assumes that if materials, labor or subcontractor cost increases, they will be absorbed by the Contractor. If not accepted within such period, such bid may be withdrawn without prejudice any time thereafter, or, revisions to the Contract Amount may be negotiated to absorb any increases to the Contract Amount.
- E. Modification or Withdrawal of Bid:
  - 1. A Bid may not be modified, withdrawn or canceled by the Bidder during the stipulated time period following the opening of Bids.
  - 2. Prior to the time and date for receipt of Bids, any Bid submitted may be modified or withdrawn. Notice of withdrawal or modification shall be in writing by the Bidder, and if a modification to the Bid, shall be so worded as to not reveal the amount of the original Bid.
- F. After Bid Opening, Bidder may withdraw his bid from consideration if the price bid was substantially lower than the other bids, providing the bid was submitted in good faith and the reason for the price bid being substantially lower was a clerical mistake as opposed to a judgment mistake and was actually due to an unintentional and substantial arithmetic error or an unintentional omission of a substantial quantity of work, labor or material made directly in the compilation of the bid. Bidder shall submit evidence of error with request to withdraw Bid. Notice of a Claim of Right to Withdraw such bid must be made in writing filed with the Owner within two business days after the conclusion of the bid opening procedure.

#### 9. ACCEPTANCE OF BID

- A. It is the intent of the Owner to award a Contract to the lowest responsible Bidder provided the Bid has been submitted in accordance with the requirements of the Bidding Documents. The Owner shall have the right to waive any informality or irregularity in any Bid or Bids received and to accept the Bid or Bids which, in his judgment, is in his own best interest.
- B. The Owner shall have the right to accept Alternates in any order or combination, and to determine the low Bidder on the basis of the sum of the Base Bid and the Alternates accepted.

#### 10. BONDS

- A. All Bid Bonds, Performance Bonds and Labor and Material Payment Bonds must be satisfactory to the Owner and the Architect.
- B. Submit with the Bid a Bid Bond on form provided in specifications , or acceptable equivalent, in the amount of ten percent (10%) of the amount bid, and payable to the Owner.
- C. A 100% Performance and 100% Payment Bond, on AIA Form A312, or acceptable equivalent, will be required to be submitted to the Owner prior to execution of the Agreement Between Owner and Contractor. Should the Contractor be unable to provide the required Bond within the specified time period, the Bidder's Bid Bond will be forfeited to the Owner and the Owner will be free to enter into an Agreement with another bidder.
- D. The Bid Bond and Performance/Payment Bond must be signed by an Authorized Agent of an acceptable

Surety Bonding Company and by the Bidder. The name and address of both the Surety and Surety's Agent must appear on the Bid Bond and Performance/Payment Bond.

- E. Bid Bonds and Performance/Payment Bonds must be supported by credentials showing the following:
  - 1. Power of Attorney of the Agent.
- F. In lieu of the Bid Bond referenced above, the bidder may submit a Cash Bond in the form of a Certified Check, Cashier's Check, or Irrevocable Letter of Credit.
- G. The amount of the Certified Check, Cashier's Check or Letter of Credit shall be equal to ten percent (10%) of the proposal.
- H. Bid Bonds shall be returned to all unsuccessful bidders immediately after the Contract is executed.
- K. The Certified Check, Cashier's Check, or Letter of Credit of the selected Bidder shall be returned upon submission of the Performance/Payment Bond.

#### 11. TIME OF COMPLETION AND LIQUIDATED DAMAGES

- A. Bidder must agree to complete the project within 300 calendar days of notice to proceed:
- B. The Bidder also agrees to pay as liquidated damages, and not as penalty, in the amount of \$750 per day for each consecutive calendar day after the established date for substantial completion that the work remains in an unfinished condition.

#### 12. CONDITIONS OF WORK

- A. Each bidder must inform him/herself fully of the conditions relating to the construction of the project and the employment of labor thereon. Failure to do so will not relieve a successful bidder of his/her obligation to furnish all material and labor necessary to carry out the provisions of his/her contract.
- B. The proposed sequencing of work is as follows:
  - Intent is to have the building enclosed prior to winter weather.
  - Contractor to perform a blower door test prior to the installation of insulation and interior finishes

#### 13. POST-BID SUBMITTALS

- A. The Bidder shall, within seven days of notification of selection for the award of a Contract for the Work, submit the following information to the Architect:
  - 1. The proprietary names and the suppliers of principal items or systems of materials and equipment proposed for the Work.
  - 2. A list of names of the Subcontractors proposed for the principal portions of the Work.
  - 3. Completed continuation sheet, AIA Document G703, copy included in this Project Manual. Include column B Description of Work and column C Schedule of Value.
  - 4. Proof of insurance and Workman's Compensation.
- B. Prior to the award of the Contract, the Architect will notify the Bidder in writing if either the Owner or the Architect has reasonable objection to any such proposed person or entity. If there is such objection, the

Bidder may, at his option, (1) withdraw his Bid, or (2) submit an acceptable substitute with an adjustment in his bid price to cover the difference in cost by such substitution. The Owner may, at his discretion, accept the adjusted bid price or he may disqualify the Bidder.

14. CONTRACT FORMS

- A. Current versions of standard A.I.A. Certificate for Payment (G702), Standard Form of Agreement (A101), and General Conditions (A201) will be the forms used in this project.

15. PREVAILING WAGE REQUIREMENTS

- A. Contractor is required to submit bid including prevailing wage.

END OF INSTRUCTIONS TO BIDDERS



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### SUPPLEMENTARY CONDITIONS

The following supplements, modify, change, delete from or add to the General Conditions of the Contract for Construction," AIA Document A201, 2007 Edition. Where any Article of the General Conditions is modified or deleted by these Supplementary Conditions, the unaltered provisions of that Article, Paragraph, Subparagraph or Clause shall remain in effect.

#### ARTICLE 3; CONTRACTOR

- A. Paragraph 3.5, add the following sub-paragraph 3.5.1:
  - 3.5.1 Products and completed Operations to be maintained for one year after substantial completion. This warranty shall be in addition to and not a limitation of other rights the Owner may have against the Contractor under the Contract Documents.
  
- B. 3.7.1 Revise as follows:
  - 3.7.1 Local building permits and any required approval by the State of Ohio will be paid for and obtained by the Owner. Any tap fees, use fees, etc, from utilities, shall be paid for by the Owner.

#### ARTICLE 11; INSURANCE

- A. 11.1.1 In the first line following the word "maintain," insert the words "in a company or companies licensed to do business in the State of Ohio."
  
- B. Add the following Clause 11.1.2.1 to 11.1.2:
  - 11.1.2.1 The insurance required by Subparagraph 11.1.2 shall be written for not less than the following, or greater if required by law:
    - 1. Workers' Compensation:

State of Ohio	Statutory
Applicable Federal	Statutory
  
    - 2. Comprehensive General Liability (including Premises and Operations; Independent Contractors' Protective; Products and Completed Operations: Broad Form Property Damage):
      - a) Bodily Injury:

\$500,000	Each Occurrence
\$1,500,000	Annual Aggregate
      - b) Property Damage:

\$500,000	Each Occurrence
\$1,500,000	Annual Aggregate
  
    - 3. Contractual Liability:
      - a) Bodily Injury:

\$500,000	Each Occurrence
\$1,500,000	Annual Aggregate
      - b) Property Damage:

\$500,000	Each Occurrence
\$1,500,000	Annual Aggregate

- 4. Comprehensive Automobile Liability:
  - a) Bodily Injury:
    - \$500,000                      Each Person
    - \$1,500,000                  Each Occurrence
  - b) Property Damage:
    - \$1,500,000                  Each Occurrence

C. Add the following Clause 11.1.3.1 to 11.1.3:

11.1.3.1 The Contractor shall furnish one copy each of Certificates of Insurance herein required for each copy of the Agreement which shall specifically set forth evidence of all coverage required by Subparagraphs 11.1.1, 11.1.2, and 11.1.2 The Contractor shall furnish to the Owner copies of any endorsements that are subsequently issued amending coverage or limits.

Name the architect and the owner as additional insured on a primary basis on the commercial general liability portion for ongoing and completed work per ISO form CG 20 10 11 85 (or on a substitute form providing equivalent coverage) or on a combination of ISO forms, CG 20 10 10 01 and CG 20 37 10 01(or on substitute forms providing equivalent coverage).

END OF SUPPLEMENTARY CONDITIONS

# AIA Document A201™ - 2017

## General Conditions of the Contract for Construction

### for the following PROJECT:

(Name and location or address)

<< >>  
<< >>

### THE OWNER:

(Name, legal status and address)

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### THE ARCHITECT:

(Name, legal status and address)

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### ADDITIONS AND DELETIONS:

The author of this document has added information needed for its completion. The author may also have revised the text of the original AIA standard form. An *Additions and Deletions Report* that notes added information as well as revisions to the standard form text is available from the author and should be reviewed.

This document has important legal consequences. Consultation with an attorney is encouraged with respect to its completion or modification.

For guidance in modifying this document to include supplementary conditions, see AIA Document A503™, Guide for Supplementary Conditions.

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## **ARTICLE 1 GENERAL PROVISIONS**

### **§ 1.1 Basic Definitions**

#### **§ 1.1.1 The Contract Documents**

The Contract Documents are enumerated in the Agreement between the Owner and Contractor (hereinafter the Agreement) and consist of the Agreement, Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement, and Modifications issued after execution of the Contract. A Modification is (1) a written amendment to the Contract signed by both parties, (2) a Change Order, (3) a Construction Change Directive, or (4) a written order for a minor change in the Work issued by the Architect. Unless specifically enumerated in the Agreement, the Contract Documents do not include the advertisement or invitation to bid, Instructions to Bidders, sample forms, other information furnished by the Owner in anticipation of receiving bids or proposals, the Contractor's bid or proposal, or portions of Addenda relating to bidding or proposal requirements.

#### **§ 1.1.2 The Contract**

The Contract Documents form the Contract for Construction. The Contract represents the entire and integrated agreement between the parties hereto and supersedes prior negotiations, representations, or agreements, either written or oral. The Contract may be amended or modified only by a Modification. The Contract Documents shall not be construed to create a contractual relationship of any kind (1) between the Contractor and the Architect or the Architect's consultants, (2) between the Owner and a Subcontractor or a Sub-subcontractor, (3) between the Owner and the Architect or the Architect's consultants, or (4) between any persons or entities other than the Owner and the Contractor. The Architect shall, however, be entitled to performance and enforcement of obligations under the Contract intended to facilitate performance of the Architect's duties.

#### **§ 1.1.3 The Work**

The term "Work" means the construction and services required by the Contract Documents, whether completed or partially completed, and includes all other labor, materials, equipment, and services provided or to be provided by the Contractor to fulfill the Contractor's obligations. The Work may constitute the whole or a part of the Project.

#### **§ 1.1.4 The Project**

The Project is the total construction of which the Work performed under the Contract Documents may be the whole or a part and which may include construction by the Owner and by Separate Contractors.

#### **§ 1.1.5 The Drawings**

The Drawings are the graphic and pictorial portions of the Contract Documents showing the design, location and dimensions of the Work, generally including plans, elevations, sections, details, schedules, and diagrams.

#### **§ 1.1.6 The Specifications**

The Specifications are that portion of the Contract Documents consisting of the written requirements for materials, equipment, systems, standards and workmanship for the Work, and performance of related services.

#### **§ 1.1.7 Instruments of Service**

Instruments of Service are representations, in any medium of expression now known or later developed, of the tangible and intangible creative work performed by the Architect and the Architect's consultants under their respective professional services agreements. Instruments of Service may include, without limitation, studies, surveys, models, sketches, drawings, specifications, and other similar materials.

#### **§ 1.1.8 Initial Decision Maker**

The Initial Decision Maker is the person identified in the Agreement to render initial decisions on Claims in accordance with Section 15.2. The Initial Decision Maker shall not show partiality to the Owner or Contractor and shall not be liable for results of interpretations or decisions rendered in good faith.

### **§ 1.2 Correlation and Intent of the Contract Documents**

**§ 1.2.1** 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 complementary, 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 indicated results.

**§ 1.2.1.1** The invalidity of any provision of the Contract Documents shall not invalidate the Contract or its remaining provisions. If it is determined that any provision of the Contract Documents violates any law, or is otherwise invalid or unenforceable, then that provision shall be revised to the extent necessary to make that provision legal and enforceable. In such case the Contract Documents shall be construed, to the fullest extent permitted by law, to give effect to the parties' intentions and purposes in executing the Contract.

**§ 1.2.2** 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.

**§ 1.2.3** Unless otherwise stated in the Contract Documents, words that have well-known technical or construction industry meanings are used in the Contract Documents in accordance with such recognized meanings.

### **§ 1.3 Capitalization**

Terms capitalized in these General Conditions include those that are (1) specifically defined, (2) the titles of numbered articles, or (3) the titles of other documents published by the American Institute of Architects.

### **§ 1.4 Interpretation**

In the interest of brevity the Contract Documents frequently omit modifying words such as "all" and "any" and articles such as "the" and "an," but the fact that a modifier or an article is absent from one statement and appears in another is not intended to affect the interpretation of either statement.

### **§ 1.5 Ownership and Use of Drawings, Specifications, and Other Instruments of Service**

**§ 1.5.1** The Architect and the Architect's consultants shall be deemed the authors and owners of their respective Instruments of Service, including the Drawings and Specifications, and retain all common law, statutory, and other reserved rights in their Instruments of Service, including copyrights. The Contractor, Subcontractors, Sub-subcontractors, and suppliers shall not own or claim a copyright in the Instruments of Service. Submittal or distribution to meet official regulatory requirements or for other purposes in connection with the Project is not to be construed as publication in derogation of the Architect's or Architect's consultants' reserved rights.

**§ 1.5.2** The Contractor, Subcontractors, Sub-subcontractors, and suppliers are authorized to use and reproduce the Instruments of Service provided to them, subject to any protocols established pursuant to Sections 1.7 and 1.8, solely and exclusively for execution of the Work. All copies made under this authorization shall bear the copyright notice, if any, shown on the Instruments of Service. The Contractor, Subcontractors, Sub-subcontractors, and suppliers may not use the Instruments of Service on other projects or for additions to the Project outside the scope of the Work without the specific written consent of the Owner, Architect, and the Architect's consultants.

### **§ 1.6 Notice**

**§ 1.6.1** Except as otherwise provided in Section 1.6.2, where the Contract Documents require one party to notify or give notice to the other party, such notice shall be provided in writing to the designated representative of the party to whom the notice is addressed and shall be deemed to have been duly served if delivered in person, by mail, by courier, or by electronic transmission if a method for electronic transmission is set forth in the Agreement.

**§ 1.6.2** Notice of Claims as provided in Section 15.1.3 shall be provided in writing and shall be deemed to have been duly served only if delivered to the designated representative of the party to whom the notice is addressed by certified or registered mail, or by courier providing proof of delivery.

### **§ 1.7 Digital Data Use and Transmission**

The parties shall agree upon protocols governing the transmission and use of Instruments of Service or any other information or documentation in digital form. The parties will use AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, to establish the protocols for the development, use, transmission, and exchange of digital data.

### **§ 1.8 Building Information Models Use and Reliance**

Any use of, or reliance on, all or a portion of a building information model without agreement to protocols governing the use of, and reliance on, the information contained in the model and without having those protocols set forth in AIA Document E203™–2013, Building Information Modeling and Digital Data Exhibit, and the requisite AIA Document G202™–2013, Project Building Information Modeling Protocol Form, shall be at the using or

relying party's sole risk and without liability to the other party and its contractors or consultants, the authors of, or contributors to, the building information model, and each of their agents and employees.

## **ARTICLE 2 OWNER**

### **§ 2.1 General**

**§ 2.1.1** The Owner is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Owner shall designate in writing a representative who shall have express authority to bind the Owner with respect to all matters requiring the Owner's approval or authorization. Except as otherwise provided in Section 4.2.1, the Architect does not have such authority. The term "Owner" means the Owner or the Owner's authorized representative.

**§ 2.1.2** The Owner shall furnish to the Contractor, within fifteen days after receipt of a written request, information necessary and relevant for the Contractor to evaluate, give notice of, or enforce mechanic's lien rights. Such information shall include a correct statement of the record legal title to the property on which the Project is located, usually referred to as the site, and the Owner's interest therein.

### **§ 2.2 Evidence of the Owner's Financial Arrangements**

**§ 2.2.1** Prior to commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract. The Contractor shall have no obligation to commence the Work until the Owner provides such evidence. If commencement of the Work is delayed under this Section 2.2.1, the Contract Time shall be extended appropriately.

**§ 2.2.2** Following commencement of the Work and upon written request by the Contractor, the Owner shall furnish to the Contractor reasonable evidence that the Owner has made financial arrangements to fulfill the Owner's obligations under the Contract only if (1) the Owner fails to make payments to the Contractor as the Contract Documents require; (2) the Contractor identifies in writing a reasonable concern regarding the Owner's ability to make payment when due; or (3) a change in the Work materially changes the Contract Sum. If the Owner fails to provide such evidence, as required, within fourteen days of the Contractor's request, the Contractor may immediately stop the Work and, in that event, shall notify the Owner that the Work has stopped. However, if the request is made because a change in the Work materially changes the Contract Sum under (3) above, the Contractor may immediately stop only that portion of the Work affected by the change until reasonable evidence is provided. If the Work is stopped under this Section 2.2.2, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided in the Contract Documents.

**§ 2.2.3** After the Owner furnishes evidence of financial arrangements under this Section 2.2, the Owner shall not materially vary such financial arrangements without prior notice to the Contractor.

**§ 2.2.4** Where the Owner has designated information furnished under this Section 2.2 as "confidential," the Contractor shall keep the information confidential and shall not disclose it to any other person. However, the Contractor may disclose "confidential" information, after seven (7) days' notice to the Owner, where disclosure is required by law, including a subpoena or other form of compulsory legal process issued by a court or governmental entity, or by court or arbitrator(s) order. The Contractor may also disclose "confidential" information to its employees, consultants, sureties, Subcontractors and their employees, Sub-subcontractors, and others who need to know the content of such information solely and exclusively for the Project and who agree to maintain the confidentiality of such information.

### **§ 2.3 Information and Services Required of the Owner**

**§ 2.3.1** Except for permits and fees that are the responsibility of the Contractor under the Contract Documents, including those required under Section 3.7.1, the Owner shall secure and pay for necessary approvals, easements, assessments and charges required for construction, use or occupancy of permanent structures or for permanent changes in existing facilities.

**§ 2.3.2** The Owner shall retain an architect lawfully licensed to practice architecture, or an entity lawfully practicing architecture, in the jurisdiction where the Project is located. That person or entity is identified as the Architect in the Agreement and is referred to throughout the Contract Documents as if singular in number.

§ 2.3.3 If the employment of the Architect terminates, the Owner shall employ a successor to whom the Contractor has no reasonable objection and whose status under the Contract Documents shall be that of the Architect.

§ 2.3.4 The Owner shall furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

§ 2.3.5 The Owner shall furnish information or services required of the Owner by the Contract Documents with reasonable promptness. The Owner shall also furnish any other information or services under the Owner's control and relevant to the Contractor's performance of the Work with reasonable promptness after receiving the Contractor's written request for such information or services.

§ 2.3.6 Unless otherwise provided in the Contract Documents, the Owner shall furnish to the Contractor one copy of the Contract Documents for purposes of making reproductions pursuant to Section 1.5.2.

#### § 2.4 Owner's Right to Stop the Work

If the Contractor fails to correct Work that is not in accordance with the requirements of the Contract Documents as required by Section 12.2 or repeatedly fails to carry out Work in accordance with the Contract Documents, the Owner may issue a written order to 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 shall 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, except to the extent required by Section 6.1.3.

#### § 2.5 Owner's Right to Carry Out the Work

If the Contractor defaults or neglects to carry out the Work in accordance with the Contract Documents and fails within a ten-day period after receipt of notice from the Owner to commence and continue correction of such default or neglect with diligence and promptness, the Owner may, without prejudice to other remedies the Owner may have, correct such default or neglect. Such action by the Owner and amounts charged to the Contractor are both subject to prior approval of the Architect and the Architect may, pursuant to Section 9.5.1, withhold or nullify a Certificate for Payment in whole or in part, to the extent reasonably necessary to reimburse the Owner for the reasonable cost of correcting such deficiencies, including Owner's expenses and compensation for the Architect's additional services made necessary by such default, neglect, or failure. If current and future payments are not sufficient to cover such amounts, the Contractor shall pay the difference to the Owner. If the Contractor disagrees with the actions of the Owner or the Architect, or the amounts claimed as costs to the Owner, the Contractor may file a Claim pursuant to Article 15.

### ARTICLE 3 CONTRACTOR

#### § 3.1 General

§ 3.1.1 The Contractor is the person or entity identified as such in the Agreement and is referred to throughout the Contract Documents as if singular in number. The Contractor shall be lawfully licensed, if required in the jurisdiction where the Project is located. The Contractor shall designate in writing a representative who shall have express authority to bind the Contractor with respect to all matters under this Contract. The term "Contractor" means the Contractor or the Contractor's authorized representative.

§ 3.1.2 The Contractor shall perform the Work in accordance with the Contract Documents.

§ 3.1.3 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 Architect in the Architect's administration of the Contract, or by tests, inspections or approvals required or performed by persons or entities other than the Contractor.

#### § 3.2 Review of Contract Documents and Field Conditions by Contractor

§ 3.2.1 Execution of the Contract by the Contractor is a representation that the Contractor has visited the site, become generally familiar with local conditions under which the Work is to be performed, and correlated personal observations with requirements of the Contract Documents.

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall, before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as

the information furnished by the Owner pursuant to Section 2.3.4, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any conditions at the site affecting it. These obligations are for the purpose of facilitating coordination and construction by the Contractor and are not for the purpose of discovering errors, omissions, or inconsistencies in the Contract Documents; however, the Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a contractor and not as a licensed design professional, unless otherwise specifically provided in the Contract Documents.

**§ 3.2.3** The Contractor is not required to ascertain that the Contract Documents are in accordance with applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, but the Contractor shall promptly report to the Architect any nonconformity discovered by or made known to the Contractor as a request for information in such form as the Architect may require.

**§ 3.2.4** If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Sections 3.2.2 or 3.2.3, the Contractor shall submit Claims as provided in Article 15. If the Contractor fails to perform the obligations of Sections 3.2.2 or 3.2.3, the Contractor shall pay such costs and damages to the Owner, subject to Section 15.1.7, as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents, for differences between field measurements or conditions and the Contract Documents, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

### **§ 3.3 Supervision and Construction Procedures**

**§ 3.3.1** 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. If the Contract Documents give specific instructions concerning construction means, methods, techniques, sequences, or procedures, the Contractor shall evaluate the jobsite safety thereof and shall be solely responsible for the jobsite safety of such means, methods, techniques, sequences, or procedures. If the Contractor determines that such means, methods, techniques, sequences or procedures may not be safe, the Contractor shall give timely notice to the Owner and Architect, and shall propose alternative means, methods, techniques, sequences, or procedures. The Architect shall evaluate the proposed alternative solely for conformance with the design intent for the completed construction. Unless the Architect objects to the Contractor's proposed alternative, the Contractor shall perform the Work using its alternative means, methods, techniques, sequences, or procedures.

**§ 3.3.2** The Contractor shall be responsible to the Owner for acts and omissions of the Contractor's employees, Subcontractors and their agents and employees, and other persons or entities performing portions of the Work for, or on behalf of, the Contractor or any of its Subcontractors.

**§ 3.3.3** The Contractor shall be responsible for inspection of portions of Work already performed to determine that such portions are in proper condition to receive subsequent Work.

### **§ 3.4 Labor and Materials**

**§ 3.4.1** Unless otherwise provided in the Contract Documents, the Contractor shall provide and pay for labor, materials, equipment, tools, construction equipment and machinery, water, heat, utilities, transportation, and other facilities and services necessary for proper execution and completion of the Work, whether temporary or permanent and whether or not incorporated or to be incorporated in the Work.

**§ 3.4.2** Except in the case of minor changes in the Work approved by the Architect in accordance with Section 3.12.8 or ordered by the Architect in accordance with Section 7.4, the Contractor may make substitutions only with the consent of the Owner, after evaluation by the Architect and in accordance with a Change Order or Construction Change Directive.

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



### **§ 3.5 Warranty**

**§ 3.5.1** The Contractor warrants to the Owner and Architect that materials and equipment furnished under the Contract will be of good quality and new unless the Contract Documents require or permit otherwise. The Contractor further warrants that the Work will conform to the requirements of the Contract Documents and will be free from defects, except for those inherent in the quality of the Work the Contract Documents require or permit. Work, materials, or equipment not conforming to these requirements may be considered defective. The Contractor's warranty excludes remedy for damage or defect caused by abuse, alterations to the Work not executed by the Contractor, improper or insufficient maintenance, improper operation, or normal wear and tear and normal usage. If required by the Architect, the Contractor shall furnish satisfactory evidence as to the kind and quality of materials and equipment.

**§ 3.5.2** All material, equipment, or other special warranties required by the Contract Documents shall be issued in the name of the Owner, or shall be transferable to the Owner, and shall commence in accordance with Section 9.8.4.

### **§ 3.6 Taxes**

The Contractor shall pay sales, consumer, use and similar taxes for the Work provided by the Contractor that are legally enacted when bids are received or negotiations concluded, whether or not yet effective or merely scheduled to go into effect.

### **§ 3.7 Permits, Fees, Notices and Compliance with Laws**

**§ 3.7.1** Unless otherwise provided in the Contract Documents, the Contractor shall secure and pay for the building permit as well as for other permits, fees, licenses, and inspections by government agencies necessary for proper execution and completion of the Work that are customarily secured after execution of the Contract and legally required at the time bids are received or negotiations concluded.

**§ 3.7.2** The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities applicable to performance of the Work.

**§ 3.7.3** If the Contractor performs Work knowing it to be contrary to applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of public authorities, the Contractor shall assume appropriate responsibility for such Work and shall bear the costs attributable to correction.

### **§ 3.7.4 Concealed or Unknown Conditions**

If the Contractor encounters conditions at the site that are (1) subsurface or otherwise concealed physical conditions that differ materially from those indicated in the Contract Documents or (2) unknown physical conditions of an unusual nature that 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, the Contractor shall promptly provide notice to the Owner and the Architect before conditions are disturbed and in no event later than 14 days after first observance of the conditions. The Architect will promptly investigate such conditions and, if the Architect determines that they differ materially and cause an increase or decrease in the Contractor's cost of, or time required for, performance of any part of the Work, will recommend that an equitable adjustment be made in the Contract Sum or Contract Time, or both. If the Architect 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 Architect shall promptly notify the Owner and Contractor, stating the reasons. If either party disputes the Architect's determination or recommendation, that party may submit a Claim as provided in Article 15.

**§ 3.7.5** If, in the course of the Work, the Contractor encounters human remains or recognizes the existence of burial markers, archaeological sites or wetlands not indicated in the Contract Documents, the Contractor shall immediately suspend any operations that would affect them and shall notify the Owner and Architect. Upon receipt of such notice, the Owner shall promptly take any action necessary to obtain governmental authorization required to resume the operations. The Contractor shall continue to suspend such operations until otherwise instructed by the Owner but shall continue with all other operations that do not affect those remains or features. Requests for adjustments in the Contract Sum and Contract Time arising from the existence of such remains or features may be made as provided in Article 15.

### **§ 3.8 Allowances**

§ 3.8.1 The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. Items covered by allowances shall be supplied for such amounts and by such persons or entities as the Owner may direct, but the Contractor shall not be required to employ persons or entities to whom the Contractor has reasonable objection.

§ 3.8.2 Unless otherwise provided in the Contract Documents,

- .1 allowances shall cover the cost to the Contractor of materials and equipment delivered at the site and all required taxes, less applicable trade discounts;
- .2 Contractor's costs for unloading and handling at the site, labor, installation costs, overhead, profit, and other expenses contemplated for stated allowance amounts shall be included in the Contract Sum but not in the allowances; and
- .3 whenever costs are more than or less than allowances, the Contract Sum shall be adjusted accordingly by Change Order. The amount of the Change Order shall reflect (1) the difference between actual costs and the allowances under Section 3.8.2.1 and (2) changes in Contractor's costs under Section 3.8.2.2.

§ 3.8.3 Materials and equipment under an allowance shall be selected by the Owner with reasonable promptness.

### § 3.9 Superintendent

§ 3.9.1 The Contractor shall employ a competent superintendent and necessary assistants who shall be in attendance at the Project site during performance of the Work. The superintendent shall represent the Contractor, and communications given to the superintendent shall be as binding as if given to the Contractor.

§ 3.9.2 The Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the name and qualifications of a proposed superintendent. Within 14 days of receipt of the information, the Architect may notify the Contractor, stating whether the Owner or the Architect (1) has reasonable objection to the proposed superintendent or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 3.9.3 The Contractor shall not employ a proposed superintendent to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not change the superintendent without the Owner's consent, which shall not unreasonably be withheld or delayed.

### § 3.10 Contractor's Construction and Submittal Schedules

§ 3.10.1 The Contractor, promptly after being awarded the Contract, shall submit for the Owner's and Architect's information a Contractor's construction schedule for the Work. The schedule shall contain detail appropriate for the Project, including (1) the date of commencement of the Work, interim schedule milestone dates, and the date of Substantial Completion; (2) an apportionment of the Work by construction activity; and (3) the time required for completion of each portion of the Work. The schedule shall provide for the orderly progression of the Work to completion and shall not exceed time limits current under the Contract Documents. The schedule shall be revised at appropriate intervals as required by the conditions of the Work and Project.

§ 3.10.2 The Contractor, promptly after being awarded the Contract and thereafter as necessary to maintain a current submittal schedule, shall submit a submittal schedule for the Architect's approval. The Architect's approval shall not be unreasonably delayed or withheld. The submittal schedule shall (1) be coordinated with the Contractor's construction schedule, and (2) allow the Architect reasonable time to review submittals. If the Contractor fails to submit a submittal schedule, or fails to provide submittals in accordance with the approved submittal schedule, the Contractor shall not be entitled to any increase in Contract Sum or extension of Contract Time based on the time required for review of submittals.

§ 3.10.3 The Contractor shall perform the Work in general accordance with the most recent schedules submitted to the Owner and Architect.

### § 3.11 Documents and Samples at the Site

The Contractor shall make available, at the Project site, the Contract Documents, including Change Orders, Construction Change Directives, and other Modifications, in good order and marked currently to indicate field changes and selections made during construction, and the approved Shop Drawings, Product Data, Samples, and similar required submittals. These shall be in electronic form or paper copy, available to the Architect and Owner,

and delivered to the Architect for submittal to the Owner upon completion of the Work as a record of the Work as constructed.

### § 3.12 Shop Drawings, Product Data and Samples

§ 3.12.1 Shop Drawings are drawings, diagrams, schedules, and other data specially prepared for the Work by the Contractor or a Subcontractor, Sub-subcontractor, manufacturer, supplier, or distributor to illustrate some portion of the Work.

§ 3.12.2 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.

§ 3.12.3 Samples are physical examples that illustrate materials, equipment, or workmanship, and establish standards by which the Work will be judged.

§ 3.12.4 Shop Drawings, Product Data, Samples, and similar submittals are not Contract Documents. Their purpose is to demonstrate how the Contractor proposes to conform to the information given and the design concept expressed in the Contract Documents for those portions of the Work for which the Contract Documents require submittals. Review by the Architect is subject to the limitations of Section 4.2.7. Informational submittals upon which the Architect is not expected to take responsive action may be so identified in the Contract Documents. Submittals that are not required by the Contract Documents may be returned by the Architect without action.

§ 3.12.5 The Contractor shall review for compliance with the Contract Documents, approve, and submit to the Architect, Shop Drawings, Product Data, Samples, and similar submittals required by the Contract Documents, in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness and in such sequence as to cause no delay in the Work or in the activities of the Owner or of Separate Contractors.

§ 3.12.6 By submitting Shop Drawings, Product Data, Samples, and similar submittals, the Contractor represents to the Owner and Architect that the Contractor has (1) reviewed and approved them, (2) determined and verified materials, field measurements and field construction criteria related thereto, or will do so, and (3) checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

§ 3.12.7 The Contractor shall perform no portion of the Work for which the Contract Documents require submittal and review of Shop Drawings, Product Data, Samples, or similar submittals, until the respective submittal has been approved by the Architect.

§ 3.12.8 The Work shall be in accordance with approved submittals except that the Contractor shall not be relieved of responsibility for deviations from the requirements of the Contract Documents by the Architect's approval of Shop Drawings, Product Data, Samples, or similar submittals, unless the Contractor has specifically notified the Architect of such deviation at the time of submittal and (1) the Architect has given written approval to the specific deviation as a minor change in the Work, or (2) a Change Order or Construction Change Directive has been issued authorizing the deviation. 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.

§ 3.12.9 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. In the absence of such notice, the Architect's approval of a resubmission shall not apply to such revisions.

§ 3.12.10 The Contractor shall not be required to provide professional services that constitute the practice of architecture or engineering unless such services are specifically required by the Contract Documents for a portion of the Work or unless the Contractor needs to provide such services in order to carry out the Contractor's responsibilities for construction means, methods, techniques, sequences, and procedures. The Contractor shall not be required to provide professional services in violation of applicable law.

§ 3.12.10.1 If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of the Contractor by the Contract Documents, the Owner and the Architect will specify all performance and design criteria that such services must satisfy. The Contractor shall be entitled to rely

upon the adequacy and accuracy of the performance and design criteria provided in the Contract Documents. The Contractor shall cause such services or certifications to be provided by an appropriately licensed design professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings, and other submittals prepared by such professional. Shop Drawings, and other submittals related to the Work, designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to the Architect. The Owner and the Architect shall be entitled to rely upon the adequacy and accuracy of the services, certifications, and approvals performed or provided by such design professionals, provided the Owner and Architect have specified to the Contractor the performance and design criteria that such services must satisfy. Pursuant to this Section 3.12.10, the Architect will review and approve or take other appropriate action on submittals only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents.

**§ 3.12.10.2** If the Contract Documents require the Contractor's design professional to certify that the Work has been performed in accordance with the design criteria, the Contractor shall furnish such certifications to the Architect at the time and in the form specified by the Architect.

### **§ 3.13 Use of Site**

The Contractor shall confine operations at the site to areas permitted by applicable laws, statutes, ordinances, codes, rules and regulations, lawful orders of public authorities, and the Contract Documents and shall not unreasonably encumber the site with materials or equipment.

### **§ 3.14 Cutting and Patching**

**§ 3.14.1** The Contractor shall be responsible for cutting, fitting, or patching required to complete the Work or to make its parts fit together properly. All areas requiring cutting, fitting, or patching shall be restored to the condition existing prior to the cutting, fitting, or patching, unless otherwise required by the Contract Documents.

**§ 3.14.2** 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 construction by the Owner or a Separate Contractor except with written consent of the Owner and of the Separate Contractor. Consent shall not be unreasonably withheld. The Contractor shall not unreasonably withhold, from the Owner or a Separate Contractor, its consent to cutting or otherwise altering the Work.

### **§ 3.15 Cleaning Up**

**§ 3.15.1** The Contractor shall keep the premises and surrounding area free from accumulation of waste materials and rubbish caused by operations under the Contract. At completion of the Work, the Contractor shall remove waste materials, rubbish, the Contractor's tools, construction equipment, machinery, and surplus materials from and about the Project.

**§ 3.15.2** If the Contractor fails to clean up as provided in the Contract Documents, the Owner may do so and the Owner shall be entitled to reimbursement from the Contractor.

### **§ 3.16 Access to Work**

The Contractor shall provide the Owner and Architect with access to the Work in preparation and progress wherever located.

### **§ 3.17 Royalties, Patents and Copyrights**

The Contractor shall pay all royalties and license fees. The Contractor shall defend suits or claims for infringement of copyrights and patent rights and shall hold the Owner and Architect harmless from loss on account thereof, but shall not be responsible for defense or loss when a particular design, process, or product of a particular manufacturer or manufacturers is required by the Contract Documents, or where the copyright violations are contained in Drawings, Specifications, or other documents prepared by the Owner or Architect. However, if an infringement of a copyright or patent is discovered by, or made known to, the Contractor, the Contractor shall be responsible for the loss unless the information is promptly furnished to the Architect.

### **§ 3.18 Indemnification**

**§ 3.18.1** To the fullest extent permitted by law, the Contractor shall indemnify and hold harmless the Owner, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages,

losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), but only to the extent caused by the negligent acts or omissions of the Contractor, a Subcontractor, 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 a party indemnified hereunder. Such obligation shall not be construed to negate, abridge, or reduce other rights or obligations of indemnity that would otherwise exist as to a party or person described in this Section 3.18.

**§ 3.18.2** In claims against any person or entity indemnified under this Section 3.18 by an employee of the Contractor, a Subcontractor, anyone directly or indirectly employed by them, or anyone for whose acts they may be liable, the indemnification obligation under Section 3.18.1 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 under workers' compensation acts, disability benefit acts, or other employee benefit acts.

## **ARTICLE 4 ARCHITECT**

### **§ 4.1 General**

**§ 4.1.1** The Architect is the person or entity retained by the Owner pursuant to Section 2.3.2 and identified as such in the Agreement.

**§ 4.1.2** Duties, responsibilities, and limitations of authority of the Architect as set forth in the Contract Documents shall not be restricted, modified, or extended without written consent of the Owner, Contractor, and Architect. Consent shall not be unreasonably withheld.

### **§ 4.2 Administration of the Contract**

**§ 4.2.1** The Architect will provide administration of the Contract as described in the Contract Documents and will be an Owner's representative during construction until the date the Architect issues the final Certificate for Payment. The Architect will have authority to act on behalf of the Owner only to the extent provided in the Contract Documents.

**§ 4.2.2** The Architect will visit the site at intervals appropriate to the stage of construction, or as otherwise agreed with the Owner, to become generally familiar with the progress and quality of the portion of the Work completed, and to determine in general if the Work observed is being performed in a manner indicating that the Work, when fully completed, will be in accordance with the Contract Documents. However, the Architect will not be required to make exhaustive or continuous on-site inspections to check the quality or quantity of the Work. The Architect will not have control over, charge of, or responsibility for the construction means, methods, techniques, sequences or procedures, or for the safety precautions and programs in connection with the Work, since these are solely the Contractor's rights and responsibilities under the Contract Documents.

**§ 4.2.3** On the basis of the site visits, the Architect will keep the Owner reasonably informed about the progress and quality of the portion of the Work completed, and promptly report to the Owner (1) known deviations from the Contract Documents, (2) known deviations from the most recent construction schedule submitted by the Contractor, and (3) defects and deficiencies observed in the Work. The Architect will not be responsible for the Contractor's failure to perform the Work in accordance with the requirements of the Contract Documents. The Architect will not have control over or charge of, and will not be responsible for acts or omissions of, the Contractor, Subcontractors, or their agents or employees, or any other persons or entities performing portions of the Work.

### **§ 4.2.4 Communications**

The Owner and Contractor shall include the Architect in all communications that relate to or affect the Architect's services or professional responsibilities. The Owner shall promptly notify the Architect of the substance of any direct communications between the Owner and the Contractor otherwise relating to the Project. Communications by and with the Architect's consultants shall be through the Architect. Communications by and with Subcontractors and suppliers shall be through the Contractor. Communications by and with Separate Contractors shall be through the Owner. The Contract Documents may specify other communication protocols.

**§ 4.2.5** Based on the Architect's evaluations of the Contractor's Applications for Payment, the Architect will review and certify the amounts due the Contractor and will issue Certificates for Payment in such amounts.

§ 4.2.6 The Architect has authority to reject Work that does not conform to the Contract Documents. Whenever the Architect considers it necessary or advisable, the Architect will have authority to require inspection or testing of the Work in accordance with Sections 13.4.2 and 13.4.3, whether or not the Work is fabricated, installed or completed. However, neither this authority of the Architect nor a decision made in good faith either to exercise or not to exercise such authority shall give rise to a duty or responsibility of the Architect to the Contractor, Subcontractors, suppliers, their agents or employees, or other persons or entities performing portions of the Work.

§ 4.2.7 The Architect will review and approve, or take other appropriate action upon, the Contractor's submittals such as Shop Drawings, Product Data, and Samples, but only for the limited purpose of checking for conformance with information given and the design concept expressed in the Contract Documents. The Architect's action will be taken in accordance with the submittal schedule approved by the Architect or, in the absence of an approved submittal schedule, with reasonable promptness while allowing sufficient time in the Architect's professional judgment to permit adequate review. Review of such submittals is not conducted for the purpose of determining the accuracy and completeness of other details such as dimensions and quantities, or for substantiating instructions for installation or performance of equipment or systems, all of which remain the responsibility of the Contractor as required by the Contract Documents. The Architect's review of the Contractor's submittals shall not relieve the Contractor of the obligations under Sections 3.3, 3.5, and 3.12. The Architect's review shall not constitute approval of safety precautions or of any construction means, methods, techniques, sequences, or procedures. The Architect's approval of a specific item shall not indicate approval of an assembly of which the item is a component.

§ 4.2.8 The Architect will prepare Change Orders and Construction Change Directives, and may order minor changes in the Work as provided in Section 7.4. The Architect will investigate and make determinations and recommendations regarding concealed and unknown conditions as provided in Section 3.7.4.

§ 4.2.9 The Architect will conduct inspections to determine the date or dates of Substantial Completion and the date of final completion; issue Certificates of Substantial Completion pursuant to Section 9.8; receive and forward to the Owner, for the Owner's review and records, written warranties and related documents required by the Contract and assembled by the Contractor pursuant to Section 9.10; and issue a final Certificate for Payment pursuant to Section 9.10.

§ 4.2.10 If the Owner and Architect agree, the Architect will provide one or more Project representatives to assist in carrying out the Architect's responsibilities at the site. The Owner shall notify the Contractor of any change in the duties, responsibilities and limitations of authority of the Project representatives.

§ 4.2.11 The Architect will interpret and decide matters concerning performance under, and requirements of, the Contract Documents on written request of either the Owner or Contractor. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness.

§ 4.2.12 Interpretations and decisions of the Architect will be consistent with the intent of, and reasonably inferable from, the Contract Documents and will be in writing or in the form of drawings. When making such interpretations and decisions, the Architect will endeavor to secure faithful performance by both Owner and Contractor, will not show partiality to either, and will not be liable for results of interpretations or decisions rendered in good faith.

§ 4.2.13 The Architect's decisions on matters relating to aesthetic effect will be final if consistent with the intent expressed in the Contract Documents.

§ 4.2.14 The Architect will review and respond to requests for information about the Contract Documents. The Architect's response to such requests will be made in writing within any time limits agreed upon or otherwise with reasonable promptness. If appropriate, the Architect will prepare and issue supplemental Drawings and Specifications in response to the requests for information.

## ARTICLE 5 SUBCONTRACTORS

### § 5.1 Definitions

§ 5.1.1 A Subcontractor is a person or entity who has a direct contract with the Contractor to perform a portion of the Work at the site. The term "Subcontractor" is referred to throughout the Contract Documents as if singular in number and means a Subcontractor or an authorized representative of the Subcontractor. The term "Subcontractor" does not include a Separate Contractor or the subcontractors of a Separate Contractor.

§ 5.1.2 A Sub-subcontractor is a person or entity who has a direct or indirect contract with a Subcontractor to perform a portion of the Work at the site. The term “Sub-subcontractor” is referred to throughout the Contract Documents as if singular in number and means a Sub-subcontractor or an authorized representative of the Sub-subcontractor.

## § 5.2 Award of Subcontracts and Other Contracts for Portions of the Work

§ 5.2.1 Unless otherwise stated in the Contract Documents, the Contractor, as soon as practicable after award of the Contract, shall notify the Owner and Architect of the persons or entities proposed for each principal portion of the Work, including those who are to furnish materials or equipment fabricated to a special design. Within 14 days of receipt of the information, the Architect may notify the Contractor whether the Owner or the Architect (1) has reasonable objection to any such proposed person or entity or (2) requires additional time for review. Failure of the Architect to provide notice within the 14-day period shall constitute notice of no reasonable objection.

§ 5.2.2 The Contractor shall not contract with a proposed person or entity to whom the Owner or Architect has made reasonable and timely objection. The Contractor shall not be required to contract with anyone to whom the Contractor has made reasonable objection.

§ 5.2.3 If the Owner or Architect has reasonable objection to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no reasonable objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any, occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractor’s Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.2.4 The Contractor shall not substitute a Subcontractor, person, or entity for one previously selected if the Owner or Architect makes reasonable objection to such substitution.

## § 5.3 Subcontractual Relations

By appropriate written agreement, the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contractor by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor’s Work that the Contractor, by these Contract Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, 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 Sub-subcontractors. The Contractor shall make available to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, upon written request of the Subcontractor, identify to the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

## § 5.4 Contingent Assignment of Subcontracts

§ 5.4.1 Each subcontract agreement for a portion of the Work is assigned by the Contractor to the Owner, provided that

- .1 assignment is effective only after termination of the Contract by the Owner for cause pursuant to Section 14.2 and only for those subcontract agreements that the Owner accepts by notifying the Subcontractor and Contractor; and
- .2 assignment is subject to the prior rights of the surety, if any, obligated under bond relating to the Contract.

When the Owner accepts the assignment of a subcontract agreement, the Owner assumes the Contractor’s rights and obligations under the subcontract.

§ 5.4.2 Upon such assignment, if the Work has been suspended for more than 30 days, the Subcontractor's compensation shall be equitably adjusted for increases in cost resulting from the suspension.

§ 5.4.3 Upon assignment to the Owner under this Section 5.4, the Owner may further assign the subcontract to a successor contractor or other entity. If the Owner assigns the subcontract to a successor contractor or other entity, the Owner shall nevertheless remain legally responsible for all of the successor contractor's obligations under the subcontract.

## **ARTICLE 6 CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS**

### **§ 6.1 Owner's Right to Perform Construction and to Award Separate Contracts**

§ 6.1.1 The term "Separate Contractor(s)" shall mean other contractors retained by the Owner under separate agreements. The Owner reserves the right to perform construction or operations related to the Project with the Owner's own forces, and with Separate Contractors retained under Conditions of the Contract substantially similar to those of this Contract, including those provisions of the Conditions of the Contract related to insurance and waiver of subrogation.

§ 6.1.2 When separate contracts are awarded for different portions of the Project or other construction or operations on the site, the term "Contractor" in the Contract Documents in each case shall mean the Contractor who executes each separate Owner-Contractor Agreement.

§ 6.1.3 The Owner shall provide for coordination of the activities of the Owner's own forces and of each Separate Contractor with the Work of the Contractor, who shall cooperate with them. The Contractor shall participate with any Separate Contractors and the Owner in reviewing their construction schedules. The Contractor shall make any revisions to its construction schedule deemed necessary after a joint review and mutual agreement. The construction schedules shall then constitute the schedules to be used by the Contractor, Separate Contractors, and the Owner until subsequently revised.

§ 6.1.4 Unless otherwise provided in the Contract Documents, when the Owner performs construction or operations related to the Project with the Owner's own forces or with Separate Contractors, the Owner or its Separate Contractors shall have the same obligations and rights that the Contractor has under the Conditions of the Contract, including, without excluding others, those stated in Article 3, this Article 6, and Articles 10, 11, and 12.

### **§ 6.2 Mutual Responsibility**

§ 6.2.1 The Contractor shall afford the Owner and Separate Contractors reasonable opportunity for introduction and storage of their materials and equipment and performance of their activities, and shall connect and coordinate the Contractor's construction and operations with theirs as required by the Contract Documents.

§ 6.2.2 If part of the Contractor's Work depends for proper execution or results upon construction or operations by the Owner or a Separate Contractor, the Contractor shall, prior to proceeding with that portion of the Work, promptly notify the Architect of apparent discrepancies or defects in the construction or operations by the Owner or Separate Contractor that would render it unsuitable for proper execution and results of the Contractor's Work. Failure of the Contractor to notify the Architect of apparent discrepancies or defects prior to proceeding with the Work shall constitute an acknowledgment that the Owner's or Separate Contractor's completed or partially completed construction is fit and proper to receive the Contractor's Work. The Contractor shall not be responsible for discrepancies or defects in the construction or operations by the Owner or Separate Contractor that are not apparent.

§ 6.2.3 The Contractor shall reimburse the Owner for costs the Owner incurs that are payable to a Separate Contractor because of the Contractor's delays, improperly timed activities or defective construction. The Owner shall be responsible to the Contractor for costs the Contractor incurs because of a Separate Contractor's delays, improperly timed activities, damage to the Work or defective construction.

§ 6.2.4 The Contractor shall promptly remedy damage that the Contractor wrongfully causes to completed or partially completed construction or to property of the Owner or Separate Contractor as provided in Section 10.2.5.

§ 6.2.5 The Owner and each Separate Contractor shall have the same responsibilities for cutting and patching as are described for the Contractor in Section 3.14.



### § 6.3 Owner's Right to Clean Up

If a dispute arises among the Contractor, Separate Contractors, and the Owner as to the responsibility under their respective contracts for maintaining the premises and surrounding area free from waste materials and rubbish, the Owner may clean up and the Architect will allocate the cost among those responsible.

## ARTICLE 7 CHANGES IN THE WORK

### § 7.1 General

§ 7.1.1 Changes in the Work may be accomplished after execution of the Contract, and without invalidating the Contract, by Change Order, Construction Change Directive or order for a minor change in the Work, subject to the limitations stated in this Article 7 and elsewhere in the Contract Documents.

§ 7.1.2 A Change Order shall be based upon agreement among the Owner, Contractor, and Architect. A Construction Change Directive requires agreement by the Owner and Architect and may or may not be agreed to by the Contractor. An order for a minor change in the Work may be issued by the Architect alone.

§ 7.1.3 Changes in the Work shall be performed under applicable provisions of the Contract Documents. The Contractor shall proceed promptly with changes in the Work, unless otherwise provided in the Change Order, Construction Change Directive, or order for a minor change in the Work.

### § 7.2 Change Orders

§ 7.2.1 A Change Order is a written instrument prepared by the Architect and signed by the Owner, Contractor, and Architect stating their agreement upon all of the following:

- .1 The change in the Work;
- .2 The amount of the adjustment, if any, in the Contract Sum; and
- .3 The extent of the adjustment, if any, in the Contract Time.

### § 7.3 Construction Change Directives

§ 7.3.1 A Construction Change Directive is a written order prepared by the Architect and signed by the Owner and Architect, directing a change in the Work prior to agreement on adjustment, if any, in the Contract Sum or Contract Time, or both. The Owner may by Construction Change Directive, without invalidating the Contract, order changes in the Work within the general scope of the Contract consisting of additions, deletions, or other revisions, the Contract Sum and Contract Time being adjusted accordingly.

§ 7.3.2 A Construction Change Directive shall be used in the absence of total agreement on the terms of a Change Order.

§ 7.3.3 If the Construction Change Directive provides for an adjustment to the Contract Sum, the adjustment shall be based on one of the following methods:

- .1 Mutual acceptance of a lump sum properly itemized and supported by sufficient substantiating data to permit evaluation;
- .2 Unit prices stated in the Contract Documents or subsequently agreed upon;
- .3 Cost to be determined in a manner agreed upon by the parties and a mutually acceptable fixed or percentage fee; or
- .4 As provided in Section 7.3.4.

§ 7.3.4 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit as set forth in the Agreement, or if no such amount is set forth in the Agreement, a reasonable amount. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.4 shall be limited to the following:

- .1 Costs of labor, including applicable payroll taxes, fringe benefits required by agreement or custom, workers' compensation insurance, and other employee costs approved by the Architect;
- .2 Costs of materials, supplies, and equipment, including cost of transportation, whether incorporated or consumed;
- .3 Rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others;

- .4 Costs of premiums for all bonds and insurance, permit fees, and sales, use, or similar taxes, directly related to the change; and
- .5 Costs of supervision and field office personnel directly attributable to the change.

§ 7.3.5 If the Contractor disagrees with the adjustment in the Contract Time, the Contractor may make a Claim in accordance with applicable provisions of Article 15.

§ 7.3.6 Upon receipt of a Construction Change Directive, the Contractor shall promptly proceed with the change in the Work involved and advise the Architect 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 or Contract Time.

§ 7.3.7 A Construction Change Directive signed by the Contractor indicates the Contractor's agreement 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.

§ 7.3.8 The amount of credit to be allowed by the Contractor to the Owner for a deletion or change that results in a net decrease in the Contract Sum shall be actual net cost as confirmed by the Architect. When both additions and credits covering related Work or substitutions are involved in a change, the allowance for overhead and profit shall be figured on the basis of net increase, if any, with respect to that change.

§ 7.3.9 Pending final determination of the total cost of a Construction Change Directive to the Owner, the Contractor may request payment for Work completed under the Construction Change Directive in Applications for Payment. The Architect will make an interim determination for purposes of monthly certification for payment for those costs and certify for payment the amount that the Architect determines, in the Architect's professional judgment, to be reasonably justified. The Architect's interim determination of cost shall adjust the Contract Sum on the same basis as a Change Order, subject to the right of either party to disagree and assert a Claim in accordance with Article 15.

§ 7.3.10 When the Owner and Contractor agree with a determination made by the Architect concerning the adjustments in the Contract Sum and Contract Time, or otherwise reach agreement upon the adjustments, such agreement shall be effective immediately and the Architect will prepare a Change Order. Change Orders may be issued for all or any part of a Construction Change Directive.

#### § 7.4 Minor Changes in the Work

The Architect may order minor changes in the Work that are consistent with the intent of the Contract Documents and do not involve an adjustment in the Contract Sum or an extension of the Contract Time. The Architect's order for minor changes shall be in writing. If the Contractor believes that the proposed minor change in the Work will affect the Contract Sum or Contract Time, the Contractor shall notify the Architect and shall not proceed to implement the change in the Work. If the Contractor performs the Work set forth in the Architect's order for a minor change without prior notice to the Architect that such change will affect the Contract Sum or Contract Time, the Contractor waives any adjustment to the Contract Sum or extension of the Contract Time.

### ARTICLE 8 TIME

#### § 8.1 Definitions

§ 8.1.1 Unless otherwise provided, Contract Time is the period of time, including authorized adjustments, allotted in the Contract Documents for Substantial Completion of the Work.

§ 8.1.2 The date of commencement of the Work is the date established in the Agreement.

§ 8.1.3 The date of Substantial Completion is the date certified by the Architect in accordance with Section 9.8.

§ 8.1.4 The term "day" as used in the Contract Documents shall mean calendar day unless otherwise specifically defined.

#### § 8.2 Progress and Completion

§ 8.2.1 Time limits stated in the Contract Documents are of the essence of the Contract. By executing the Agreement, the Contractor confirms that the Contract Time is a reasonable period for performing the Work.

§ 8.2.2 The Contractor shall not knowingly, except by agreement or instruction of the Owner in writing, commence the Work prior to the effective date of insurance required to be furnished by the Contractor and Owner.

§ 8.2.3 The Contractor shall proceed expeditiously with adequate forces and shall achieve Substantial Completion within the Contract Time.

### § 8.3 Delays and Extensions of Time

§ 8.3.1 If the Contractor is delayed at any time in the commencement or progress of the Work by (1) an act or neglect of the Owner or Architect, of an employee of either, or of a Separate Contractor; (2) by changes ordered in the Work; (3) by labor disputes, fire, unusual delay in deliveries, unavoidable casualties, adverse weather conditions documented in accordance with Section 15.1.6.2, or other causes beyond the Contractor's control; (4) by delay authorized by the Owner pending mediation and binding dispute resolution; or (5) by other causes that the Contractor asserts, and the Architect determines, justify delay, then the Contract Time shall be extended for such reasonable time as the Architect may determine.

§ 8.3.2 Claims relating to time shall be made in accordance with applicable provisions of Article 15.

§ 8.3.3 This Section 8.3 does not preclude recovery of damages for delay by either party under other provisions of the Contract Documents.

## ARTICLE 9 PAYMENTS AND COMPLETION

### § 9.1 Contract Sum

§ 9.1.1 The Contract Sum is stated in the Agreement and, including authorized adjustments, is the total amount payable by the Owner to the Contractor for performance of the Work under the Contract Documents.

§ 9.1.2 If unit prices are stated in the Contract Documents or subsequently agreed upon, and if quantities originally contemplated are materially changed so that application of such unit prices to the actual quantities causes substantial inequity to the Owner or Contractor, the applicable unit prices shall be equitably adjusted.

### § 9.2 Schedule of Values

Where the Contract is based on a stipulated sum or Guaranteed Maximum Price, the Contractor shall submit a schedule of values to the Architect before the first Application for Payment, allocating the entire Contract Sum to the various portions of the Work. The schedule of values shall be prepared in the form, and supported by the data to substantiate its accuracy, required by the Architect. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's Applications for Payment. Any changes to the schedule of values shall be submitted to the Architect and supported by such data to substantiate its accuracy as the Architect may require, and unless objected to by the Architect, shall be used as a basis for reviewing the Contractor's subsequent Applications for Payment.

### § 9.3 Applications for Payment

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of the Work. The application shall be notarized, if required, and supported by all data substantiating the Contractor's right to payment that the Owner or Architect require, such as copies of requisitions, and releases and waivers of liens from Subcontractors and suppliers, and shall reflect retainage if provided for in the Contract Documents.

§ 9.3.1.1 As provided in Section 7.3.9, such applications may include requests for payment on account of changes in the Work that have been properly authorized by Construction Change Directives, or by interim determinations of the Architect, but not yet included in Change Orders.

§ 9.3.1.2 Applications for Payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay a Subcontractor or supplier, unless such Work has been performed by others whom the Contractor intends to pay.

§ 9.3.2 Unless otherwise provided in the Contract Documents, payments shall be made on account of materials and equipment delivered and suitably stored at the site for subsequent incorporation in the Work. If approved in advance by the Owner, payment may similarly be made for materials and equipment suitably stored off the site at a location

agreed upon in writing. Payment for materials and equipment stored on or off the site shall be conditioned upon compliance by the Contractor with procedures satisfactory to the Owner to establish the Owner's title to such materials and equipment or otherwise protect the Owner's interest, and shall include the costs of applicable insurance, storage, and transportation to the site, for such materials and equipment stored off the site.

**§ 9.3.3** The Contractor warrants that title to all Work covered by an Application for Payment will pass to the Owner no later than the time of payment. The Contractor further warrants that upon submittal of an Application for Payment all Work for which Certificates for Payment have been previously issued and payments received from the Owner shall, to the best of the Contractor's knowledge, information, and belief, be free and clear of liens, claims, security interests, or encumbrances, in favor of the Contractor, Subcontractors, suppliers, or other persons or entities that provided labor, materials, and equipment relating to the Work.

#### **§ 9.4 Certificates for Payment**

**§ 9.4.1** The Architect will, within seven days after receipt of the Contractor's Application for Payment, either (1) issue to the Owner a Certificate for Payment in the full amount of the Application for Payment, with a copy to the Contractor; or (2) issue to the Owner a Certificate for Payment for such amount as the Architect determines is properly due, and notify the Contractor and Owner of the Architect's reasons for withholding certification in part as provided in Section 9.5.1; or (3) withhold certification of the entire Application for Payment, and notify the Contractor and Owner of the Architect's reason for withholding certification in whole as provided in Section 9.5.1.

**§ 9.4.2** The issuance of a Certificate for Payment will constitute a representation by the Architect to the Owner, based on the Architect's evaluation of the Work and the data in the Application for Payment, that, to the best of the Architect's knowledge, information, and belief, the Work has progressed to the point indicated, the quality of the Work is in accordance with the Contract Documents, and that the Contractor is entitled to payment in the amount certified. The foregoing representations are subject to an evaluation of the Work for conformance with the Contract Documents upon Substantial Completion, to results of subsequent tests and inspections, to correction of minor deviations from the Contract Documents prior to completion, and to specific qualifications expressed by the Architect. However, the issuance of a Certificate for Payment will not be a representation that the Architect has (1) made exhaustive or continuous on-site inspections to check the quality or quantity of the Work; (2) reviewed construction means, methods, techniques, sequences, or procedures; (3) reviewed copies of requisitions received from Subcontractors and suppliers and other data requested by the Owner to substantiate the Contractor's right to payment; or (4) made examination to ascertain how or for what purpose the Contractor has used money previously paid on account of the Contract Sum.

#### **§ 9.5 Decisions to Withhold Certification**

**§ 9.5.1** The Architect may withhold a Certificate for Payment in whole or in part, to the extent reasonably necessary to protect the Owner, if in the Architect's opinion the representations to the Owner required by Section 9.4.2 cannot be made. If the Architect is unable to certify payment in the amount of the Application, the Architect will notify the Contractor and Owner as provided in Section 9.4.1. If the Contractor and Architect cannot agree on a revised amount, the Architect will promptly issue a Certificate for Payment for the amount for which the Architect is able to make such representations to the Owner. The Architect may also withhold a Certificate for Payment or, because of subsequently discovered evidence, may nullify the whole or a part of a Certificate for Payment previously issued, to such extent as may be necessary in the Architect's opinion to protect the Owner from loss for which the Contractor is responsible, including loss resulting from acts and omissions described in Section 3.3.2, because of

- .1 defective Work not remedied;
- .2 third party claims filed or reasonable evidence indicating probable filing of such claims, unless security acceptable to the Owner is provided by the Contractor;
- .3 failure of the Contractor to make payments properly to Subcontractors or suppliers for labor, materials or equipment;
- .4 reasonable evidence that the Work cannot be completed for the unpaid balance of the Contract Sum;
- .5 damage to the Owner or a Separate Contractor;
- .6 reasonable evidence that the Work will not be completed within the Contract Time, and that the unpaid balance would not be adequate to cover actual or liquidated damages for the anticipated delay;
- or
- .7 repeated failure to carry out the Work in accordance with the Contract Documents.

**§ 9.5.2** When either party disputes the Architect's decision regarding a Certificate for Payment under Section 9.5.1, in whole or in part, that party may submit a Claim in accordance with Article 15.

§ 9.5.3 When the reasons for withholding certification are removed, certification will be made for amounts previously withheld.

§ 9.5.4 If the Architect withholds certification for payment under Section 9.5.1.3, the Owner may, at its sole option, issue joint checks to the Contractor and to any Subcontractor or supplier to whom the Contractor failed to make payment for Work properly performed or material or equipment suitably delivered. If the Owner makes payments by joint check, the Owner shall notify the Architect and the Contractor shall reflect such payment on its next Application for Payment.

## § 9.6 Progress Payments

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect.

§ 9.6.2 The Contractor shall pay each Subcontractor, no later than seven days after receipt of payment from the Owner, the amount to which the Subcontractor is entitled, reflecting percentages actually retained from payments to the Contractor on account of the Subcontractor's portion of the Work. The Contractor shall, by appropriate agreement with each Subcontractor, require each Subcontractor to make payments to Sub-subcontractors in a similar manner.

§ 9.6.3 The Architect will, on request, furnish to a Subcontractor, if practicable, information regarding percentages of completion or amounts applied for by the Contractor and action taken thereon by the Architect and Owner on account of portions of the Work done by such Subcontractor.

§ 9.6.4 The Owner has the right to request written evidence from the Contractor that the Contractor has properly paid Subcontractors and suppliers amounts paid by the Owner to the Contractor for subcontracted Work. If the Contractor fails to furnish such evidence within seven days, the Owner shall have the right to contact Subcontractors and suppliers to ascertain whether they have been properly paid. Neither the Owner nor Architect shall have an obligation to pay, or to see to the payment of money to, a Subcontractor or supplier, except as may otherwise be required by law.

§ 9.6.5 The Contractor's payments to suppliers shall be treated in a manner similar to that provided in Sections 9.6.2, 9.6.3 and 9.6.4.

§ 9.6.6 A Certificate for Payment, 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.

§ 9.6.7 Unless the Contractor provides the Owner with a payment bond in the full penal sum of the Contract Sum, payments received by the Contractor for Work properly performed by Subcontractors or provided by suppliers shall be held by the Contractor for those Subcontractors or suppliers who performed Work or furnished materials, or both, under contract with the Contractor for which payment was made by the Owner. Nothing contained herein shall require money to be placed in a separate account and not commingled with money of the Contractor, create any fiduciary liability or tort liability on the part of the Contractor for breach of trust, or entitle any person or entity to an award of punitive damages against the Contractor for breach of the requirements of this provision.

§ 9.6.8 Provided the Owner has fulfilled its payment obligations under the Contract Documents, the Contractor shall defend and indemnify the Owner from all loss, liability, damage or expense, including reasonable attorney's fees and litigation expenses, arising out of any lien claim or other claim for payment by any Subcontractor or supplier of any tier. Upon receipt of notice of a lien claim or other claim for payment, the Owner shall notify the Contractor. If approved by the applicable court, when required, the Contractor may substitute a surety bond for the property against which the lien or other claim for payment has been asserted.

## § 9.7 Failure of Payment

If the Architect does not issue a Certificate for Payment, through no fault of the Contractor, within seven days after receipt of the Contractor's Application for Payment, or if the Owner does not pay the Contractor within seven days after the date established in the Contract Documents, the amount certified by the Architect or awarded by binding dispute resolution, then the Contractor may, upon seven additional days' notice to the Owner and Architect, stop the Work until payment of the amount owing has been received. The Contract Time shall be extended appropriately and

the Contract Sum shall be increased by the amount of the Contractor's reasonable costs of shutdown, delay and start-up, plus interest as provided for in the Contract Documents.

### **§ 9.8 Substantial Completion**

**§ 9.8.1** Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use.

**§ 9.8.2** When the Contractor considers that the Work, or a portion thereof which the Owner agrees to accept separately, is substantially complete, the Contractor shall prepare and submit to the Architect a comprehensive list of items to be completed or corrected prior to final payment. Failure to include an item on such list does not alter the responsibility of the Contractor to complete all Work in accordance with the Contract Documents.

**§ 9.8.3** Upon receipt of the Contractor's list, the Architect will make an inspection to determine whether the Work or designated portion thereof is substantially complete. If the Architect's inspection discloses any item, whether or not included on the Contractor's list, which is not sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work or designated portion thereof for its intended use, the Contractor shall, before issuance of the Certificate of Substantial Completion, complete or correct such item upon notification by the Architect. In such case, the Contractor shall then submit a request for another inspection by the Architect to determine Substantial Completion.

**§ 9.8.4** When the Work or designated portion thereof is substantially complete, the Architect will prepare a Certificate of Substantial Completion that shall establish the date of Substantial Completion; establish responsibilities of the Owner and Contractor for security, maintenance, heat, utilities, damage to the Work and insurance; and fix the time within which the Contractor shall finish all items on the list accompanying the Certificate. Warranties required by the Contract Documents shall commence on the date of Substantial Completion of the Work or designated portion thereof unless otherwise provided in the Certificate of Substantial Completion.

**§ 9.8.5** The Certificate of Substantial Completion shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in the Certificate. Upon such acceptance, and consent of surety if any, the Owner shall make payment of retainage applying to the Work or designated portion thereof. Such payment shall be adjusted for Work that is incomplete or not in accordance with the requirements of the Contract Documents.

### **§ 9.9 Partial Occupancy or Use**

**§ 9.9.1** 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, provided such occupancy or use is consented to by the insurer and authorized by public authorities having jurisdiction over the Project. Such partial occupancy or use may commence whether or not the portion is substantially complete, provided the Owner and Contractor have accepted in writing the responsibilities assigned to each of them for payments, retainage, if any, security, maintenance, heat, utilities, damage to the Work and insurance, and have agreed in writing concerning the period for correction of the Work and commencement of warranties required by the Contract Documents. When the Contractor considers a portion substantially complete, the Contractor shall prepare and submit a list to the Architect as provided under Section 9.8.2. 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 written agreement between the Owner and Contractor or, if no agreement is reached, by decision of the Architect.

**§ 9.9.2** Immediately prior to such partial occupancy or use, the Owner, Contractor, and Architect 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.

**§ 9.9.3** 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.

### **§ 9.10 Final Completion and Final Payment**

**§ 9.10.1** Upon receipt of the Contractor's notice that the Work is ready for final inspection and acceptance and upon receipt of a final Application for Payment, the Architect will promptly make such inspection. When the Architect finds the Work acceptable under the Contract Documents and the Contract fully performed, the Architect will promptly issue a final Certificate for Payment stating that to the best of the Architect's knowledge, information and

belief, and on the basis of the Architect's on-site visits and inspections, the Work has been completed in accordance with the Contract Documents and that the entire balance found to be due the Contractor and noted in the final Certificate is due and payable. The Architect's final Certificate for Payment will constitute a further representation that conditions listed in Section 9.10.2 as precedent to the Contractor's being entitled to final payment have been fulfilled.

**§ 9.10.2** Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment, (5) documentation of any special warranties, such as manufacturers' warranties or specific Subcontractor warranties, and (6) if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts and releases and waivers of liens, claims, security interests, or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien, claim, security interest, or encumbrance. If a lien, claim, security interest, or encumbrance remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging the lien, claim, security interest, or encumbrance, including all costs and reasonable attorneys' fees.

**§ 9.10.3** If, after Substantial Completion of the Work, final completion thereof is materially delayed through no fault of the Contractor or by issuance of Change Orders affecting final completion, and the Architect so confirms, the Owner shall, upon application by the Contractor and certification by the Architect, and without terminating the Contract, make payment of the balance due for that portion of the Work fully completed, corrected, and accepted. If the remaining balance for Work not fully completed or corrected is less than retainage stipulated in the Contract Documents, and if bonds have been furnished, the written consent of the surety to payment of the balance due for that portion of the Work fully completed and accepted shall be submitted by the Contractor to the Architect prior to certification of such payment. Such payment shall be made under terms and conditions governing final payment, except that it shall not constitute a waiver of Claims.

**§ 9.10.4** The making of final payment shall constitute a waiver of Claims by the Owner except those arising from

- .1 liens, Claims, security interests, or encumbrances arising out of the Contract and unsettled;
- .2 failure of the Work to comply with the requirements of the Contract Documents;
- .3 terms of special warranties required by the Contract Documents; or
- .4 audits performed by the Owner, if permitted by the Contract Documents, after final payment.

**§ 9.10.5** Acceptance of final payment by the Contractor, a Subcontractor, or a supplier, shall constitute a waiver of claims by that payee except those previously made in writing and identified by that payee as unsettled at the time of final Application for Payment.

## **ARTICLE 10 PROTECTION OF PERSONS AND PROPERTY**

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

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the performance of the Contract.

### **§ 10.2 Safety of Persons and Property**

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

- .1 employees on the Work 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, a Subcontractor, or a Sub-subcontractor; 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 comply with, and give notices required by applicable laws, statutes, ordinances, codes, rules and 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 implement, erect, and maintain, as required by existing conditions and performance of the Contract, reasonable safeguards for safety and protection, including posting danger signs and other warnings against hazards; promulgating safety regulations; and notifying the owners and users of adjacent sites and utilities of the safeguards.

§ 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 utmost 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 referred to in Sections 10.2.1.2 and 10.2.1.3 caused in whole or in part by the Contractor, a Subcontractor, a Sub-subcontractor, 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 Sections 10.2.1.2 and 10.2.1.3. The Contractor may make a Claim for the cost to remedy the damage or loss to the extent such damage or loss is attributable to acts or omissions of the Owner or 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 obligations under Section 3.18.

§ 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. This person shall be the Contractor's superintendent unless otherwise designated by the Contractor in writing to the Owner and Architect.

§ 10.2.7 The Contractor shall not permit any part of the construction or site to be loaded so as to cause damage or create an unsafe condition.

#### § 10.2.8 Injury or Damage to Person or Property

If either party suffers injury or damage to person or property because of an act or omission of the other party, or of others for whose acts such party is legally responsible, notice of the injury or damage, whether or not insured, shall be given to the other party within a reasonable time not exceeding 21 days after discovery. The notice shall provide sufficient detail to enable the other party to investigate the matter.

#### § 10.3 Hazardous Materials and Substances

§ 10.3.1 The Contractor is responsible for compliance with any requirements included in the Contract Documents regarding hazardous materials or substances. If the Contractor encounters a hazardous material or substance not addressed in the Contract Documents and if reasonable precautions will be inadequate to prevent foreseeable bodily injury or death to persons resulting from a material or substance, including but not limited to asbestos or polychlorinated biphenyl (PCB), encountered on the site by the Contractor, the Contractor shall, upon recognizing the condition, immediately stop Work in the affected area and notify the Owner and Architect of the condition.

§ 10.3.2 Upon receipt of the Contractor's notice, the Owner shall obtain the services of a licensed laboratory to verify the presence or absence of the material or substance reported by the Contractor and, in the event such material or substance is found to be present, to cause it to be rendered harmless. Unless otherwise required by the Contract Documents, the Owner shall furnish in writing to the Contractor and Architect the names and qualifications of persons or entities who are to perform tests verifying the presence or absence of the material or substance or who are to perform the task of removal or safe containment of the material or substance. The Contractor and the Architect will promptly reply to the Owner in writing stating whether or not either has reasonable objection to the persons or entities proposed by the Owner. If either the Contractor or Architect has an objection to a person or entity proposed by the Owner, the Owner shall propose another to whom the Contractor and the Architect have no reasonable objection. When the material or substance has been rendered harmless, Work in the affected area shall resume upon written agreement of the Owner and Contractor. By Change Order, the Contract Time shall be extended appropriately and the Contract Sum shall be increased by the amount of the Contractor's reasonable additional costs of shutdown, delay, and start-up.



§ 10.3.3 To the fullest extent permitted by law, the Owner shall indemnify and hold harmless the Contractor, Subcontractors, Architect, Architect's consultants, and agents and employees of any of them from and against claims, damages, losses, and expenses, including but not limited to attorneys' fees, arising out of or resulting from performance of the Work in the affected area if in fact the material or substance presents the risk of bodily injury or death as described in Section 10.3.1 and has not been rendered harmless, provided that such claim, damage, loss, or expense is attributable to bodily injury, sickness, disease or death, or to injury to or destruction of tangible property (other than the Work itself), except to the extent that such damage, loss, or expense is due to the fault or negligence of the party seeking indemnity.

§ 10.3.4 The Owner shall not be responsible under this Section 10.3 for hazardous materials or substances the Contractor brings to the site unless such materials or substances are required by the Contract Documents. The Owner shall be responsible for hazardous materials or substances required by the Contract Documents, except to the extent of the Contractor's fault or negligence in the use and handling of such materials or substances.

§ 10.3.5 The Contractor shall reimburse the Owner for the cost and expense the Owner incurs (1) for remediation of hazardous materials or substances the Contractor brings to the site and negligently handles, or (2) where the Contractor fails to perform its obligations under Section 10.3.1, except to the extent that the cost and expense are due to the Owner's fault or negligence.

§ 10.3.6 If, without negligence on the part of the Contractor, the Contractor is held liable by a government agency for the cost of remediation of a hazardous material or substance solely by reason of performing Work as required by the Contract Documents, the Owner shall reimburse the Contractor for all cost and expense thereby incurred.

#### § 10.4 Emergencies

In an emergency affecting safety of persons or property, the Contractor shall act, at the Contractor's discretion, to prevent threatened damage, injury, or loss. Additional compensation or extension of time claimed by the Contractor on account of an emergency shall be determined as provided in Article 15 and Article 7.

### ARTICLE 11 INSURANCE AND BONDS

#### § 11.1 Contractor's Insurance and Bonds

§ 11.1.1 The Contractor shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract Documents. The Contractor shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located. The Owner, Architect, and Architect's consultants shall be named as additional insureds under the Contractor's commercial general liability policy or as otherwise described in the Contract Documents.

§ 11.1.2 The Contractor shall provide surety bonds of the types, for such penal sums, and subject to such terms and conditions as required by the Contract Documents. The Contractor shall purchase and maintain the required bonds from a company or companies lawfully authorized to issue surety bonds in the jurisdiction where the Project is located.

§ 11.1.3 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 or shall authorize a copy to be furnished.

§ 11.1.4 **Notice of Cancellation or Expiration of Contractor's Required Insurance.** Within three (3) business days of the date the Contractor becomes aware of an impending or actual cancellation or expiration of any insurance required by the Contract Documents, the Contractor shall provide notice to the Owner of such impending or actual cancellation or expiration. Upon receipt of notice from the Contractor, the Owner shall, unless the lapse in coverage arises from an act or omission of the Owner, have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by the Contractor. The furnishing of notice by the Contractor shall not relieve the Contractor of any contractual obligation to provide any required coverage.

#### § 11.2 Owner's Insurance

§ 11.2.1 The Owner shall purchase and maintain insurance of the types and limits of liability, containing the endorsements, and subject to the terms and conditions, as described in the Agreement or elsewhere in the Contract

Documents. The Owner shall purchase and maintain the required insurance from an insurance company or insurance companies lawfully authorized to issue insurance in the jurisdiction where the Project is located.

**§ 11.2.2 Failure to Purchase Required Property Insurance.** If the Owner fails to purchase and maintain the required property insurance, with all of the coverages and in the amounts described in the Agreement or elsewhere in the Contract Documents, the Owner shall inform the Contractor in writing prior to commencement of the Work. Upon receipt of notice from the Owner, the Contractor may delay commencement of the Work and may obtain insurance that will protect the interests of the Contractor, Subcontractors, and Sub-Subcontractors in the Work. When the failure to provide coverage has been cured or resolved, the Contract Sum and Contract Time shall be equitably adjusted. In the event the Owner fails to procure coverage, the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent the loss to the Owner would have been covered by the insurance to have been procured by the Owner. The cost of the insurance shall be charged to the Owner by a Change Order. If the Owner does not provide written notice, and the Contractor is damaged by the failure or neglect of the Owner to purchase or maintain the required insurance, the Owner shall reimburse the Contractor for all reasonable costs and damages attributable thereto.

**§ 11.2.3 Notice of Cancellation or Expiration of Owner's Required Property Insurance.** Within three (3) business days of the date the Owner becomes aware of an impending or actual cancellation or expiration of any property insurance required by the Contract Documents, the Owner shall provide notice to the Contractor of such impending or actual cancellation or expiration. Unless the lapse in coverage arises from an act or omission of the Contractor: (1) the Contractor, upon receipt of notice from the Owner, shall have the right to stop the Work until the lapse in coverage has been cured by the procurement of replacement coverage by either the Owner or the Contractor; (2) the Contract Time and Contract Sum shall be equitably adjusted; and (3) the Owner waives all rights against the Contractor, Subcontractors, and Sub-subcontractors to the extent any loss to the Owner would have been covered by the insurance had it not expired or been cancelled. If the Contractor purchases replacement coverage, the cost of the insurance shall be charged to the Owner by an appropriate Change Order. The furnishing of notice by the Owner shall not relieve the Owner of any contractual obligation to provide required insurance.

### **§ 11.3 Waivers of Subrogation**

**§ 11.3.1** The Owner and Contractor waive all rights against (1) each other and any of their subcontractors, sub-subcontractors, agents, and employees, each of the other; (2) the Architect and Architect's consultants; and (3) Separate Contractors, if any, and any of their subcontractors, sub-subcontractors, agents, and employees, for damages caused by fire, or other causes of loss, to the extent those losses are covered by property insurance required by the Agreement or other property insurance applicable to the Project, except such rights as they have to proceeds of such insurance. The Owner or Contractor, as appropriate, shall require similar written waivers in favor of the individuals and entities identified above from the Architect, Architect's consultants, Separate Contractors, subcontractors, and sub-subcontractors. The policies of insurance purchased and maintained by each person or entity agreeing to waive claims pursuant to this section 11.3.1 shall not prohibit this waiver of subrogation. This waiver of subrogation shall be effective as to a person or entity (1) even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, (2) even though that person or entity did not pay the insurance premium directly or indirectly, or (3) whether or not the person or entity had an insurable interest in the damaged property.

**§ 11.3.2** If during the Project construction period the Owner insures properties, real or personal or both, at or adjacent to the site by property insurance under policies separate from those insuring the Project, or if after final payment property insurance is to be provided on the completed Project through a policy or policies other than those insuring the Project during the construction period, to the extent permissible by such policies, the Owner waives all rights in accordance with the terms of Section 11.3.1 for damages caused by fire or other causes of loss covered by this separate property insurance.

### **§ 11.4 Loss of Use, Business Interruption, and Delay in Completion Insurance**

The Owner, at the Owner's option, may purchase and maintain insurance that will protect the Owner against loss of use of the Owner's property, or the inability to conduct normal operations, due to fire or other causes of loss. The Owner waives all rights of action against the Contractor and Architect for loss of use of the Owner's property, due to fire or other hazards however caused.

### **§11.5 Adjustment and Settlement of Insured Loss**

**§ 11.5.1** A loss insured under the property insurance required by the Agreement shall be adjusted by the Owner as fiduciary and made payable to the Owner as fiduciary for the insureds, as their interests may appear, subject to requirements of any applicable mortgagee clause and of Section 11.5.2. The Owner shall pay the Architect and Contractor their just shares of insurance proceeds received by the Owner, and by appropriate agreements the Architect and Contractor shall make payments to their consultants and Subcontractors in similar manner.

**§ 11.5.2** Prior to settlement of an insured loss, the Owner shall notify the Contractor of the terms of the proposed settlement as well as the proposed allocation of the insurance proceeds. The Contractor shall have 14 days from receipt of notice to object to the proposed settlement or allocation of the proceeds. If the Contractor does not object, the Owner shall settle the loss and the Contractor shall be bound by the settlement and allocation. Upon receipt, the Owner shall deposit the insurance proceeds in a separate account and make the appropriate distributions. Thereafter, if no other agreement is made or the Owner does not terminate the Contract for convenience, the Owner and Contractor shall execute a Change Order for reconstruction of the damaged or destroyed Work in the amount allocated for that purpose. If the Contractor timely objects to either the terms of the proposed settlement or the allocation of the proceeds, the Owner may proceed to settle the insured loss, and any dispute between the Owner and Contractor arising out of the settlement or allocation of the proceeds shall be resolved pursuant to Article 15. Pending resolution of any dispute, the Owner may issue a Construction Change Directive for the reconstruction of the damaged or destroyed Work.

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

### **§ 12.1 Uncovering of 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 must, if requested in writing by the Architect, be uncovered for the Architect's examination 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 that the Architect has not specifically requested to examine prior to its being covered, the Architect may request to see such Work and it shall be uncovered by the Contractor. If such Work is in accordance with the Contract Documents, the Contractor shall be entitled to an equitable adjustment to the Contract Sum and Contract Time as may be appropriate. If such Work is not in accordance with the Contract Documents, the costs of uncovering the Work, and the cost of correction, shall be at the Contractor's expense.

### **§ 12.2 Correction of Work**

#### **§ 12.2.1 Before Substantial Completion**

The Contractor shall promptly correct Work rejected by the Architect or failing to conform to the requirements of the Contract Documents, discovered before Substantial Completion and whether or not fabricated, installed or completed. Costs of correcting such rejected Work, including additional testing and inspections, the cost of uncovering and replacement, and compensation for the Architect's services and expenses made necessary thereby, shall be at the Contractor's expense.

#### **§ 12.2.2 After Substantial Completion**

**§ 12.2.2.1** In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the Work or designated portion thereof or after the date for commencement of warranties established under Section 9.9.1, or by terms of any applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of notice from the Owner to do so, unless the Owner has previously given the Contractor a written acceptance of such condition. The Owner shall give such notice promptly after discovery of the condition. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.5.

**§ 12.2.2.2** The one-year period for correction of Work shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between Substantial Completion and the actual completion of that portion of the Work.

**§ 12.2.2.3** The one-year period for correction of Work shall not be extended by corrective Work performed by the Contractor pursuant to this Section 12.2.

§ 12.2.3 The Contractor shall remove from the site portions of the Work that 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 The Contractor shall bear the cost of correcting destroyed or damaged construction of the Owner or Separate Contractors, whether completed or partially completed, caused by the Contractor's correction or removal of Work that is not in accordance with the requirements of the Contract Documents.

§ 12.2.5 Nothing contained in this Section 12.2 shall be construed to establish a period of limitation with respect to other obligations the Contractor has under the Contract Documents. Establishment of the one-year period for correction of Work as described in Section 12.2.2 relates only to the specific obligation of the Contractor to correct 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 other than specifically to correct the Work.

### § 12.3 Acceptance of Nonconforming Work

If the Owner prefers to accept Work that is not in accordance with the requirements of the Contract Documents, the Owner may do so instead of requiring its removal and correction, in which case the Contract Sum will be reduced as appropriate and equitable. Such adjustment shall be effected whether or not final payment has been made.

## ARTICLE 13 MISCELLANEOUS PROVISIONS

### § 13.1 Governing Law

The Contract shall be governed by the law of the place where the Project is located, excluding that jurisdiction's choice of law rules. If the parties have selected arbitration as the method of binding dispute resolution, the Federal Arbitration Act shall govern Section 15.4.

### § 13.2 Successors and Assigns

§ 13.2.1 The Owner and Contractor respectively bind themselves, their partners, successors, assigns, and legal representatives to covenants, agreements, and obligations contained in the Contract Documents. Except as provided in Section 13.2.2, neither party to the Contract shall assign the Contract as a whole without written consent of the other. If either party attempts to make an assignment without such consent, that party shall nevertheless remain legally responsible for all obligations under the Contract.

§ 13.2.2 The Owner may, without consent of the Contractor, assign the Contract to a lender providing construction financing for the Project, if the lender assumes the Owner's rights and obligations under the Contract Documents. The Contractor shall execute all consents reasonably required to facilitate the assignment.

### § 13.3 Rights and Remedies

§ 13.3.1 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.

§ 13.3.2 No action or failure to act by the Owner, Architect, or Contractor shall constitute a waiver of a right or duty afforded them under the Contract, nor shall such action or failure to act constitute approval of or acquiescence in a breach thereunder, except as may be specifically agreed upon in writing.

### § 13.4 Tests and Inspections

§ 13.4.1 Tests, inspections, and approvals of portions of the Work shall be made as required by the Contract Documents and by applicable laws, statutes, ordinances, codes, rules, and regulations or lawful orders of public authorities. Unless otherwise provided, the Contractor shall make arrangements for such tests, inspections, and approvals with an independent testing laboratory or entity acceptable to the Owner, or with the appropriate public authority, and shall bear all related costs of tests, inspections, and approvals. The Contractor shall give the Architect timely notice of when and where tests and inspections are to be made so that the Architect may be present for such procedures. The Owner shall bear costs of tests, inspections, or approvals that do not become requirements until after bids are received or negotiations concluded. The Owner shall directly arrange and pay for tests, inspections, or approvals where building codes or applicable laws or regulations so require.

§ 13.4.2 If the Architect, Owner, or public authorities having jurisdiction determine that portions of the Work require additional testing, inspection, or approval not included under Section 13.4.1, the Architect will, upon written authorization from the Owner, instruct the Contractor to make arrangements for such additional testing, inspection, or approval, by an entity acceptable to the Owner, and the Contractor shall give timely notice to the Architect of when and where tests and inspections are to be made so that the Architect may be present for such procedures. Such costs, except as provided in Section 13.4.3, shall be at the Owner's expense.

§ 13.4.3 If procedures for testing, inspection, or approval under Sections 13.4.1 and 13.4.2 reveal failure of the portions of the Work to comply with requirements established by the Contract Documents, all costs made necessary by such failure, including those of repeated procedures and compensation for the Architect's services and expenses, shall be at the Contractor's expense.

§ 13.4.4 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 Architect.

§ 13.4.5 If the Architect is to observe tests, inspections, or approvals required by the Contract Documents, the Architect will do so promptly and, where practicable, at the normal place of testing.

§ 13.4.6 Tests or inspections conducted pursuant to the Contract Documents shall be made promptly to avoid unreasonable delay in the Work.

### § 13.5 Interest

Payments due and unpaid under the Contract Documents shall bear interest from the date payment is due at the rate the parties agree upon in writing or, in the absence thereof, at the legal rate prevailing from time to time at the place where the Project is located.

## ARTICLE 14 TERMINATION OR SUSPENSION OF THE CONTRACT

### § 14.1 Termination by the Contractor

§ 14.1.1 The Contractor may terminate the Contract if the Work is stopped for a period of 30 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, for any of the following reasons:

- .1 Issuance of an order of a court or other public authority having jurisdiction that requires all Work to be stopped;
- .2 An act of government, such as a declaration of national emergency, that requires all Work to be stopped;
- .3 Because the Architect has not issued a Certificate for Payment and has not notified the Contractor of the reason for withholding certification as provided in Section 9.4.1, or because the Owner has not made payment on a Certificate for Payment within the time stated in the Contract Documents; or
- .4 The Owner has failed to furnish to the Contractor reasonable evidence as required by Section 2.2.

§ 14.1.2 The Contractor may terminate the Contract if, through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, their agents or employees, or any other persons or entities performing portions of the Work, repeated suspensions, delays, or interruptions of the entire Work by the Owner as described in Section 14.3, constitute in the aggregate more than 100 percent of the total number of days scheduled for completion, or 120 days in any 365-day period, whichever is less.

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon seven days' notice to the Owner and Architect, terminate the Contract and recover from the Owner payment for Work executed, as well as reasonable overhead and profit on Work not executed, and costs incurred by reason of such termination.

§ 14.1.4 If the Work is stopped for a period of 60 consecutive days through no act or fault of the Contractor, a Subcontractor, a Sub-subcontractor, or their agents or employees or any other persons or entities performing portions of the Work because the Owner has repeatedly failed to fulfill the Owner's obligations under the Contract Documents with respect to matters important to the progress of the Work, the Contractor may, upon seven additional days' notice to the Owner and the Architect, terminate the Contract and recover from the Owner as provided in Section 14.1.3.

### § 14.2 Termination by the Owner for Cause

- § 14.2.1 The Owner may terminate the Contract if the Contractor
- .1 repeatedly refuses or fails to supply enough properly skilled workers or proper materials;
  - .2 fails to make payment to Subcontractors or suppliers in accordance with the respective agreements between the Contractor and the Subcontractors or suppliers;
  - .3 repeatedly disregards applicable laws, statutes, ordinances, codes, rules and regulations, or lawful orders of a public authority; or
  - .4 otherwise is guilty of substantial breach of a provision of the Contract Documents.

§ 14.2.2 When any of the reasons described in Section 14.2.1 exist, and upon certification by the Architect that sufficient cause exists to justify such action, the Owner may, without prejudice to any other rights or remedies of the Owner and after giving the Contractor and the Contractor's surety, if any, seven days' notice, terminate employment of the Contractor and may, subject to any prior rights of the surety:

- .1 Exclude the Contractor from the site and take possession of all materials, equipment, tools, and construction equipment and machinery thereon owned by the Contractor;
- .2 Accept assignment of subcontracts pursuant to Section 5.4; and
- .3 Finish the Work by whatever reasonable method the Owner may deem expedient. Upon written request of the Contractor, the Owner shall furnish to the Contractor a detailed accounting of the costs incurred by the Owner in finishing the Work.

§ 14.2.3 When the Owner terminates the Contract for one of the reasons stated in Section 14.2.1, the Contractor shall not be entitled to receive further payment until the Work is finished.

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

### § 14.3 Suspension by the Owner for Convenience

§ 14.3.1 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.

§ 14.3.2 The Contract Sum and Contract Time shall be adjusted for increases in the cost and time caused by suspension, delay, or interruption under Section 14.3.1. Adjustment of the Contract Sum shall include profit. No adjustment shall 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 is responsible; or
- .2 that an equitable adjustment is made or denied under another provision of the Contract.

### § 14.4 Termination by the Owner for Convenience

§ 14.4.1 The Owner may, at any time, terminate the Contract for the Owner's convenience and without cause.

§ 14.4.2 Upon receipt of notice from the Owner of such termination for the Owner's convenience, the Contractor shall

- .1 cease operations as directed by the Owner in the notice;
- .2 take actions necessary, or that the Owner may direct, for the protection and preservation of the Work; and
- .3 except for Work directed to be performed prior to the effective date of termination stated in the notice, terminate all existing subcontracts and purchase orders and enter into no further subcontracts and purchase orders.

§ 14.4.3 In case of such termination for the Owner's convenience, the Owner shall pay the Contractor for Work properly executed; costs incurred by reason of the termination, including costs attributable to termination of Subcontracts; and the termination fee, if any, set forth in the Agreement.

## ARTICLE 15 CLAIMS AND DISPUTES

### § 15.1 Claims

### § 15.1.1 Definition

A Claim is a demand or assertion by one of the parties seeking, as a matter of right, payment of money, a change in the Contract Time, or other relief with respect to the terms of the Contract. The term "Claim" also includes other disputes and matters in question between the Owner and Contractor arising out of or relating to the Contract. The responsibility to substantiate Claims shall rest with the party making the Claim. This Section 15.1.1 does not require the Owner to file a Claim in order to impose liquidated damages in accordance with the Contract Documents.

### § 15.1.2 Time Limits on Claims

The Owner and Contractor shall commence all Claims and causes of action against the other and arising out of or related to the Contract, whether in contract, tort, breach of warranty or otherwise, in accordance with the requirements of the binding dispute resolution method selected in the Agreement and within the period specified by applicable law, but in any case not more than 10 years after the date of Substantial Completion of the Work. The Owner and Contractor waive all Claims and causes of action not commenced in accordance with this Section 15.1.2.

### § 15.1.3 Notice of Claims

§ 15.1.3.1 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered prior to expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party under this Section 15.1.3.1 shall be initiated within 21 days after occurrence of the event giving rise to such Claim or within 21 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later.

§ 15.1.3.2 Claims by either the Owner or Contractor, where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2, shall be initiated by notice to the other party. In such event, no decision by the Initial Decision Maker is required.

### § 15.1.4 Continuing Contract Performance

§ 15.1.4.1 Pending final resolution of a Claim, except as otherwise agreed in writing or as provided in Section 9.7 and Article 14, the Contractor shall proceed diligently with performance of the Contract and the Owner shall continue to make payments in accordance with the Contract Documents.

§ 15.1.4.2 The Contract Sum and Contract Time shall be adjusted in accordance with the Initial Decision Maker's decision, subject to the right of either party to proceed in accordance with this Article 15. The Architect will issue Certificates for Payment in accordance with the decision of the Initial Decision Maker.

### § 15.1.5 Claims for Additional Cost

If the Contractor wishes to make a Claim for an increase in the Contract Sum, notice as provided in Section 15.1.3 shall be given before proceeding to execute the portion of the Work that is the subject of the Claim. Prior notice is not required for Claims relating to an emergency endangering life or property arising under Section 10.4.

### § 15.1.6 Claims for Additional Time

§ 15.1.6.1 If the Contractor wishes to make a Claim for an increase in the Contract Time, notice as provided in Section 15.1.3 shall be given. The Contractor's Claim shall include an estimate of cost and of probable effect of delay on progress of the Work. In the case of a continuing delay, only one Claim is necessary.

§ 15.1.6.2 If adverse weather conditions are the basis for a Claim for additional time, such Claim shall be documented by data substantiating that weather conditions were abnormal for the period of time, could not have been reasonably anticipated, and had an adverse effect on the scheduled construction.

### § 15.1.7 Waiver of Claims for Consequential Damages

The Contractor and Owner waive Claims against each other for consequential damages arising out of or relating to this Contract. This mutual waiver includes

- .1 damages incurred by the Owner for rental expenses, for losses of use, income, profit, financing, business and reputation, and for loss of management or employee productivity or of the services of such persons; and
- .2 damages incurred by the Contractor for principal office expenses including the compensation of personnel stationed there, for losses of financing, business and reputation, and for loss of profit, except anticipated profit arising directly from the Work.

This mutual waiver is applicable, without limitation, to all consequential damages due to either party's termination in accordance with Article 14. Nothing contained in this Section 15.1.7 shall be deemed to preclude assessment of liquidated damages, when applicable, in accordance with the requirements of the Contract Documents.

## **§ 15.2 Initial Decision**

**§ 15.2.1** Claims, excluding those where the condition giving rise to the Claim is first discovered after expiration of the period for correction of the Work set forth in Section 12.2.2 or arising under Sections 10.3, 10.4, and 11.5, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation of any Claim. If an initial decision has not been rendered within 30 days after the Claim has been referred to the Initial Decision Maker, the party asserting the Claim may demand mediation and binding dispute resolution without a decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

**§ 15.2.2** The Initial Decision Maker will review Claims and within ten days of the receipt of a Claim take one or more of the following actions: (1) request additional supporting data from the claimant or a response with supporting data from the other party, (2) reject the Claim in whole or in part, (3) approve the Claim, (4) suggest a compromise, or (5) advise the parties that the Initial Decision Maker is unable to resolve the Claim if the Initial Decision Maker lacks sufficient information to evaluate the merits of the Claim or if the Initial Decision Maker concludes that, in the Initial Decision Maker's sole discretion, it would be inappropriate for the Initial Decision Maker to resolve the Claim.

**§ 15.2.3** In evaluating Claims, the Initial Decision Maker may, but shall not be obligated to, consult with or seek information from either party or from persons with special knowledge or expertise who may assist the Initial Decision Maker in rendering a decision. The Initial Decision Maker may request the Owner to authorize retention of such persons at the Owner's expense.

**§ 15.2.4** If the Initial Decision Maker requests a party to provide a response to a Claim or to furnish additional supporting data, such party shall respond, within ten days after receipt of the request, and shall either (1) provide a response on the requested supporting data, (2) advise the Initial Decision Maker when the response or supporting data will be furnished, or (3) advise the Initial Decision Maker that no supporting data will be furnished. Upon receipt of the response or supporting data, if any, the Initial Decision Maker will either reject or approve the Claim in whole or in part.

**§ 15.2.5** The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and, if the parties fail to resolve their dispute through mediation, to binding dispute resolution.

**§ 15.2.6** Either party may file for mediation of an initial decision at any time, subject to the terms of Section 15.2.6.1.

**§ 15.2.6.1** Either party may, within 30 days from the date of receipt of an initial decision, demand in writing that the other party file for mediation. If such a demand is made and the party receiving the demand fails to file for mediation within 30 days after receipt thereof, then both parties waive their rights to mediate or pursue binding dispute resolution proceedings with respect to the initial decision.

**§ 15.2.7** In the event of a Claim against the Contractor, the Owner may, but is not obligated to, notify the surety, if any, of the nature and amount of the Claim. If the Claim relates to a possibility of a Contractor's default, the Owner may, but is not obligated to, notify the surety and request the surety's assistance in resolving the controversy.

**§ 15.2.8** If a Claim relates to or is the subject of a mechanic's lien, the party asserting such Claim may proceed in accordance with applicable law to comply with the lien notice or filing deadlines.



### § 15.3 Mediation

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract, except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.7, shall be subject to mediation as a condition precedent to binding dispute resolution.

§ 15.3.2 The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.3.3 Either party may, within 30 days from the date that mediation has been concluded without resolution of the dispute or 60 days after mediation has been demanded without resolution of the dispute, demand in writing that the other party file for binding dispute resolution. If such a demand is made and the party receiving the demand fails to file for binding dispute resolution within 60 days after receipt thereof, then both parties waive their rights to binding dispute resolution proceedings with respect to the initial decision.

§ 15.3.4 The parties shall share the mediator's fee and any filing fees equally. The mediation shall be held in the place where the Project is located, unless another location is mutually agreed upon. Agreements reached in mediation shall be enforceable as settlement agreements in any court having jurisdiction thereof.

### § 15.4 Arbitration

§ 15.4.1 If the parties have selected arbitration as the method for binding dispute resolution in the Agreement, any Claim subject to, but not resolved by, mediation shall be subject to arbitration which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Arbitration Rules in effect on the date of the Agreement. The Arbitration shall be conducted in the place where the Project is located, unless another location is mutually agreed upon. A demand for arbitration shall be made in writing, delivered to the other party to the Contract, and filed with the person or entity administering the arbitration. The party filing a notice of demand for arbitration must assert in the demand all Claims then known to that party on which arbitration is permitted to be demanded.

§ 15.4.1.1 A demand for arbitration shall be made no earlier than concurrently with the filing of a request for mediation, but in no event shall it be made after the date when the institution of legal or equitable proceedings based on the Claim would be barred by the applicable statute of limitations. For statute of limitations purposes, receipt of a written demand for arbitration by the person or entity administering the arbitration shall constitute the institution of legal or equitable proceedings based on the Claim.

§ 15.4.2 The award rendered by the arbitrator or arbitrators shall be final, and judgment may be entered upon it in accordance with applicable law in any court having jurisdiction thereof.

§ 15.4.3 The foregoing agreement to arbitrate and other agreements to arbitrate with an additional person or entity duly consented to by parties to the Agreement, shall be specifically enforceable under applicable law in any court having jurisdiction thereof.

### § 15.4.4 Consolidation or Joinder

§ 15.4.4.1 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may consolidate an arbitration conducted under this Agreement with any other arbitration to which it is a party provided that (1) the arbitration agreement governing the other arbitration permits consolidation, (2) the arbitrations to be consolidated substantially involve common questions of law or fact, and (3) the arbitrations employ materially similar procedural rules and methods for selecting arbitrator(s).

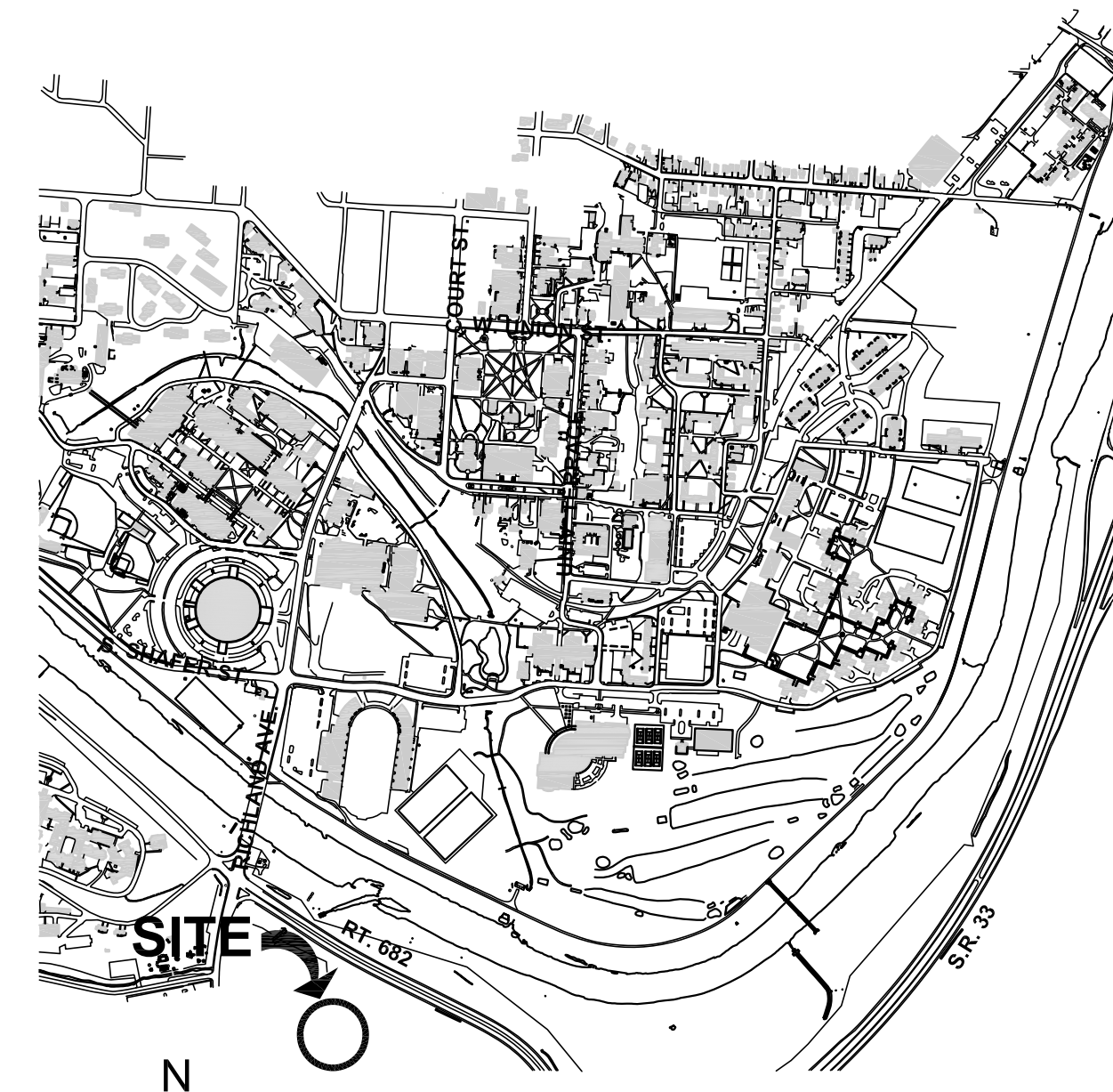
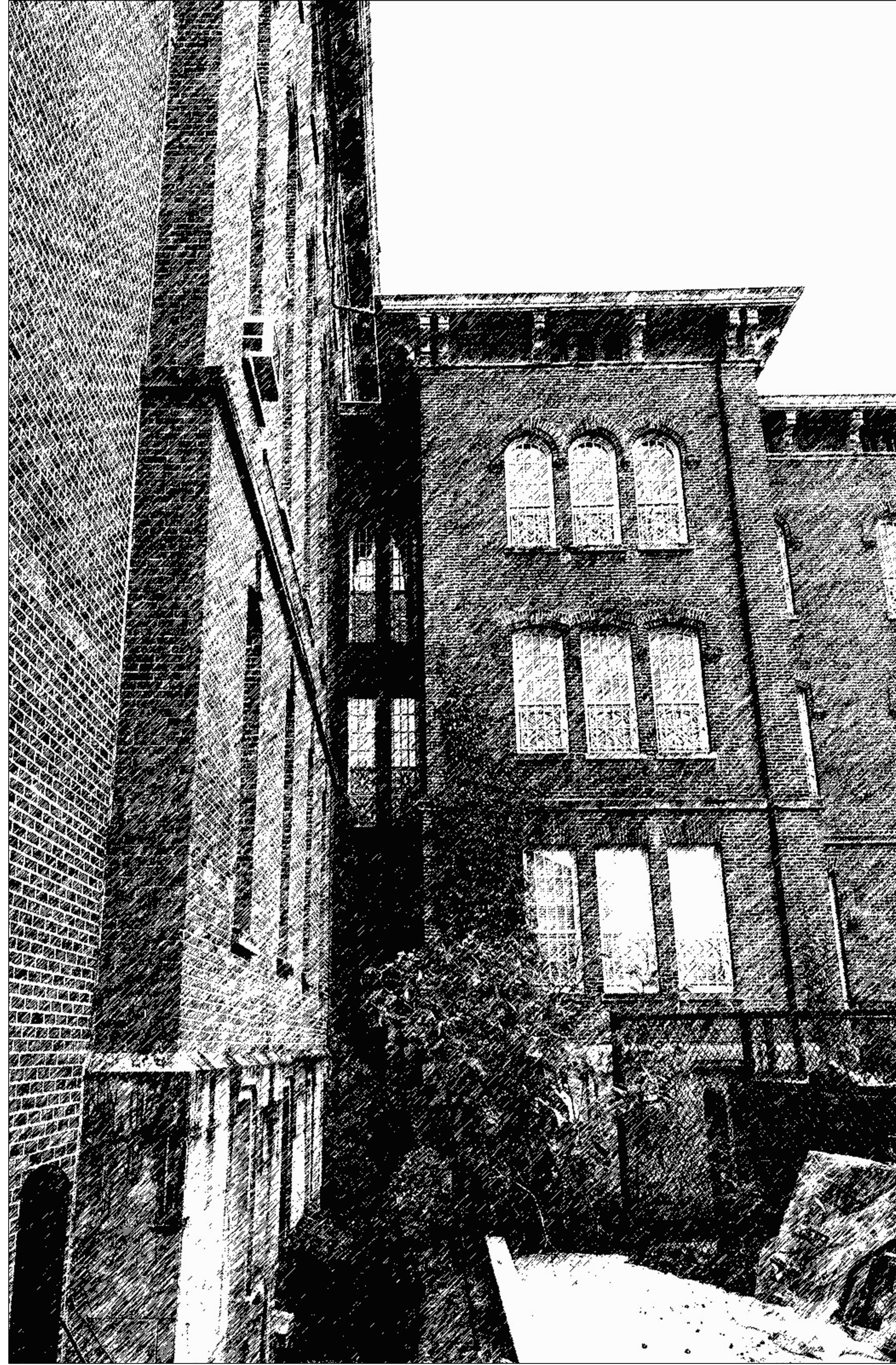
§ 15.4.4.2 Subject to the rules of the American Arbitration Association or other applicable arbitration rules, either party may include by joinder persons or entities substantially involved in a common question of law or fact whose presence is required if complete relief is to be accorded in arbitration, provided that the party sought to be joined

consents in writing to such joinder. Consent to arbitration involving an additional person or entity shall not constitute consent to arbitration of any claim, dispute or other matter in question not described in the written consent.

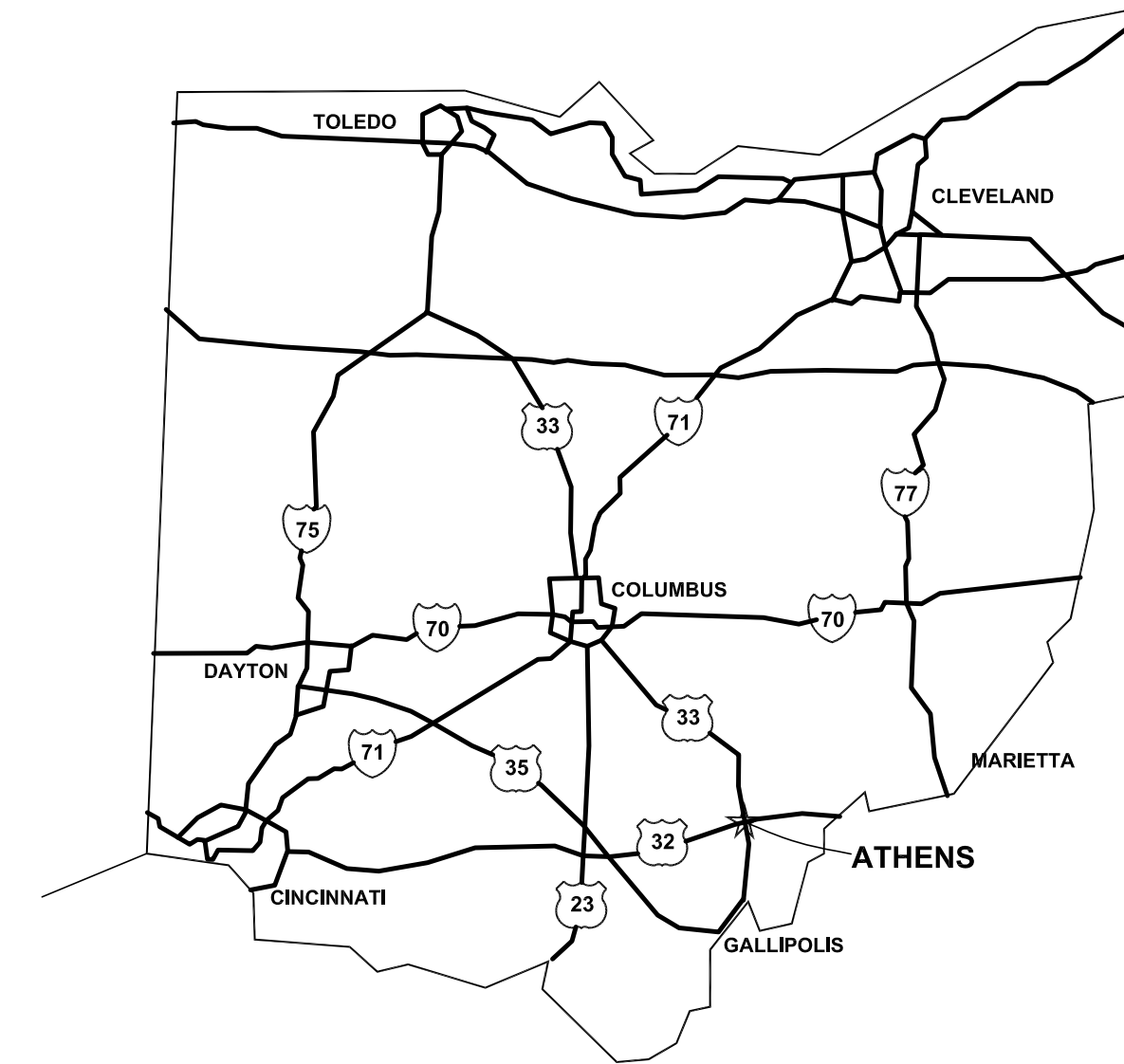
**§ 15.4.4.3** The Owner and Contractor grant to any person or entity made a party to an arbitration conducted under this Section 15.4, whether by joinder or consolidation, the same rights of joinder and consolidation as those of the Owner and Contractor under this Agreement.

# **WORK SPECIFICATIONS**

# OHIO MUSEUM COMPLEX LIN HALL HVAC IMPROVEMENTS OHIO UNIVERSITY, THE RIDGES ATHENS, OHIO



**E5 VICINITY MAP**  
SCALE: NTS

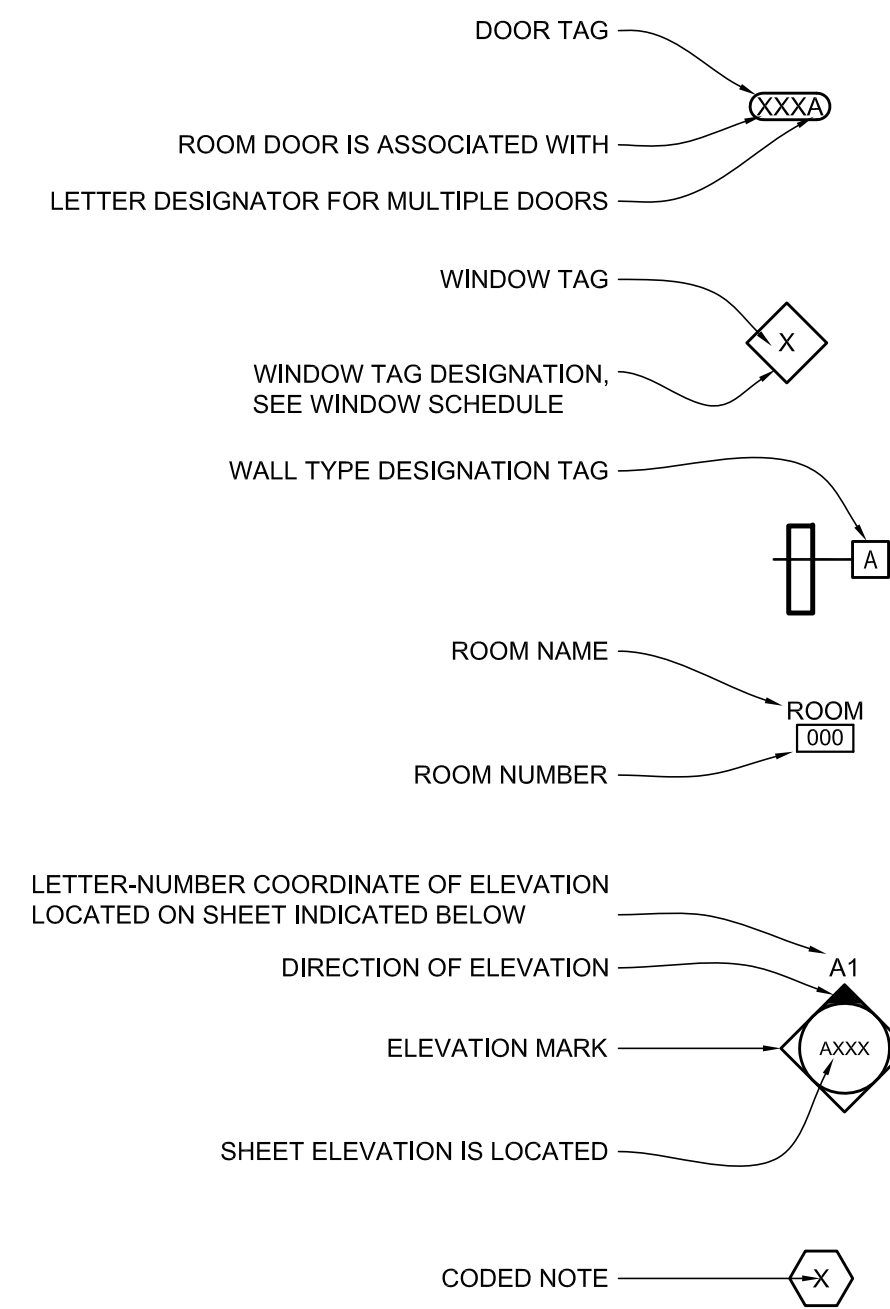
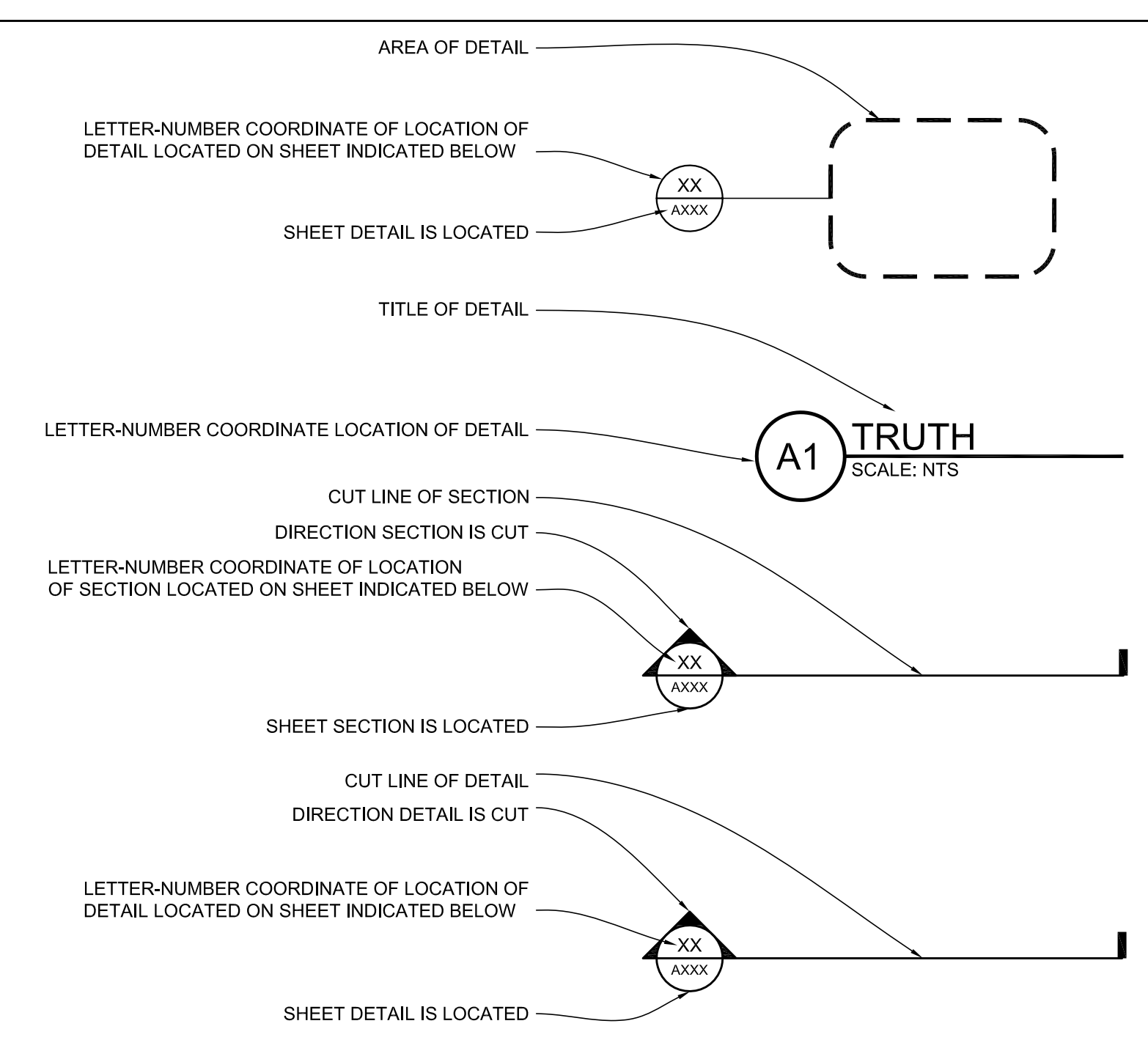


**E2 STATE MAP**  
SCALE: NTS

## DRAWING INDEX:

SHEET#	DESCRIPTION	DATE	REVISION
G101	COVER PAGE, DRAWING INDEX, STATE MAP, KEY PLANS, CODE NOTES		
D101	BASEMENT FLOOR PLAN		
D102	FIRST FLOOR PLAN		
D103	SECOND FLOOR PLAN		
D104	THIRD FLOOR PLAN		
D105	FOURTH FLOOR PLAN		
FP3	THIRD FLOOR FIRE PROTECTION PLAN		
FP4	FOURTH FLOOR FIRE PROTECTION PLAN		
P0	BASEMENT PLUMBING PLAN		
P2	SECOND FLOOR PLUMBING PLAN		
P3	THIRD FLOOR PLUMBING PLAN		
P4	FOURTH FLOOR PLUMBING PLAN		
P5	PLUMBING DETAILS		
H0	BASEMENT HVAC PLAN		
H1	BASEMENT HVAC PLAN - NEW WORK		
H2	SECOND FLOOR HVAC PLAN		
H3.1	THIRD FLOOR HVAC PLAN		
H3.2	FOURTH FLOOR HVAC PLAN		
H4.1	FOURTH FLOOR HVAC PIPING PLAN		
H4.2	FOURTH FLOOR PIPING HVAC PLAN		
H5	HVAC DETAILS		
H6	HVAC SCHEDULES		
H7	HVAC SCHEDULES		
E0	BASEMENT POWER PLANS		
E2	SECOND FLOOR POWER PLAN		
E3	THIRD FLOOR POWER PLANS		
E4	FOURTH FLOOR POWER PLANS		
E5	ONE LINE DIAGRAMS		
E6	ELECTRIC SCHEDULES		

## SYMBOLS LEGEND:



## ABBREVIATIONS:

ACT	ACOUSTICAL CEILING TILE	OC	ON CENTER
ADA	AMERICAN DISABILITIES ACT (ACCESSIBILITY GUIDELINES)	OSB	ORIENTED STRAND BOARD
AFF	ABOVE FINISH FLOOR	P-LAM	PLASTIC LAMINATE
ALT	ALTERNATE	PLF	POUNDS PER LINEAR FOOT
ALUM	ALUMINUM	PNL	PANEL
ACP	ACOUSTICAL CEILING PANEL	PSF	POUNDS PER SQUARE FOOT
BOG	BOTTOM OF GRID	PSK	POLY SCRIM KRAFT
CLG	CEILING	PT	PAINT
CLR	CLEAR	PTD	PAINTED
CMU	CONCRETE MASONRY UNIT	R	RADIUS
CPT	CARPET	REQ'D	REQUIRED
CONC	CONCRETE	R.O.	ROUGH OPENING
DIA	DIAMETER	RCB	RUBBER COVE BASE
DW	DRYWALL	SF	SQUARE FEET
EA	EACH	SHT	SHEET
EL	ELEVATION	SIM	SIMILAR
ELEV	ELEVATION	SLNT	SEALANT
EXG	EXISTING	SOV	SHUT OFF VALVE
EXIST	EXISTING	SQ FT	SQUARE FEET
EXT	EXTERIOR	SUSP	SUSPENDED
FIN	FINISH	TH	THICK
GYP.BD.	GYPSSUM WALL BOARD	TYP	TYPICAL
HC	HANDICAP	UNO	UNLESS NOTED OTHERWISE
HDWE	HARDWARE	VIF	VERIFY IN FIELD
HM	HOLLOW METAL	VCT	VINYL COMPOSITION TILE
INT	INTERIOR	W	WITH
LGFM	LIGHT GAUGE METAL FRAMING	WD	WOOD
MAT	MATERIAL	WDH	WOOD DOOR HOLLOW CORE
MAX	MAXIMUM		
MIN	MINIMUM		

## CODE NOTES:

<p>2024 OHIO BUILDING CODE 2024 OHIO MECHANICAL CODE 2024 OHIO PLUMBING CODE NFPA 70 - 24 NATIONAL ELECTRICAL CODE</p>	
<p><b>SCOPE OF WORK</b> THE SCOPE OF THIS PROJECT IS A RENOVATION. ALSO INCLUDED ARE PLUMBING, HVAC AND ELECTRICAL UPGRADES AND RENOVATIONS</p>	
<p><b>EXISTING BUILDING</b></p> <p>OCCUPANCY USE GROUP: B CONSTRUCTION TYPE: 2B BUILDING HEIGHT ABOVE GP: 43'-4" FT BUILDING STORIES ABOVE GP: 4 STORIES BUILDING AREA: 63,574 G.S.F. BASEMENT: 5,947 S.F. FIRST FLOOR: 15,029 S.F. SECOND FLOOR: 15,866 S.F. THIRD FLOOR: 15,866 S.F. FOURTH FLOOR: 10,866 S.F. BUILDING OCCUPANT LOAD: 433 PERSONS</p> <p>BUILDING SPRINKLER SYSTEM: N/A LIMITED AREA SPRINKLER SYSTEM: N/A IN RACK SPRINKLER SYSTEM: N/A DEMAND PRESSURE AT BASE OF RISER: N/A TYPE 1 WOOD SPRINKLER SYSTEM: N/A BUILDING FIRE ALARM SYSTEM: EXISTING MODIFIED - NFPA 72 BUILDING FIRE DETECTION SYSTEM: EXISTING MODIFIED - NFPA 72 BUILDING SMOKE DETECTION SYSTEM: EXISTING MODIFIED - NFPA 72</p>	
<p><b>BUILDING RATINGS</b></p> <p>STRUCTURAL FRAME: 0 HR EXTERIOR BEARING WALLS: 0 HR INTERIOR BEARING WALLS: 0 HR NON BEARING WALLS: 0 HR FLOOR CONSTRUCTION: 0 HR ROOF CONSTRUCTION: 0 HR SHAFT ENCLOSURES: 2 HR CORRIDORS: 0.5 HR EXIT STAIRS: 2 HR WALLS BETWEEN DORM RM AND OTHER USES: 1 HR</p>	<p><b>WIND LOAD</b></p> <p>BASIC WIND SPEED: --- MPH WIND EXPOSURE: ---</p> <p><b>EARTHQUAKE DESIGN DATA</b></p> <p>SEISMIC DESIGN CATEGORY: --- SITE CLASS: ---</p> <p><b>DESIGN LOADS</b></p> <p>MISCELLANEOUS LOADS HANDRAIL VERTICAL DOWN LOAD: 200# CONCENTRATED, 50PLF GUARD HORIZONTAL LOAD: 50 PLF INTERIOR WALL HORIZONTAL LOAD: 5 PSF TRUSS TOP CHORD DEAD LOAD: --- PSF TRUSS BOTTOM CHORD DEAD LOAD: --- PSF ASSUMED SOIL BEARING: 1500 PSF</p>



807A0D, Inc.  
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EMAIL: office@bdtai.com

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PROFESSIONAL SEAL

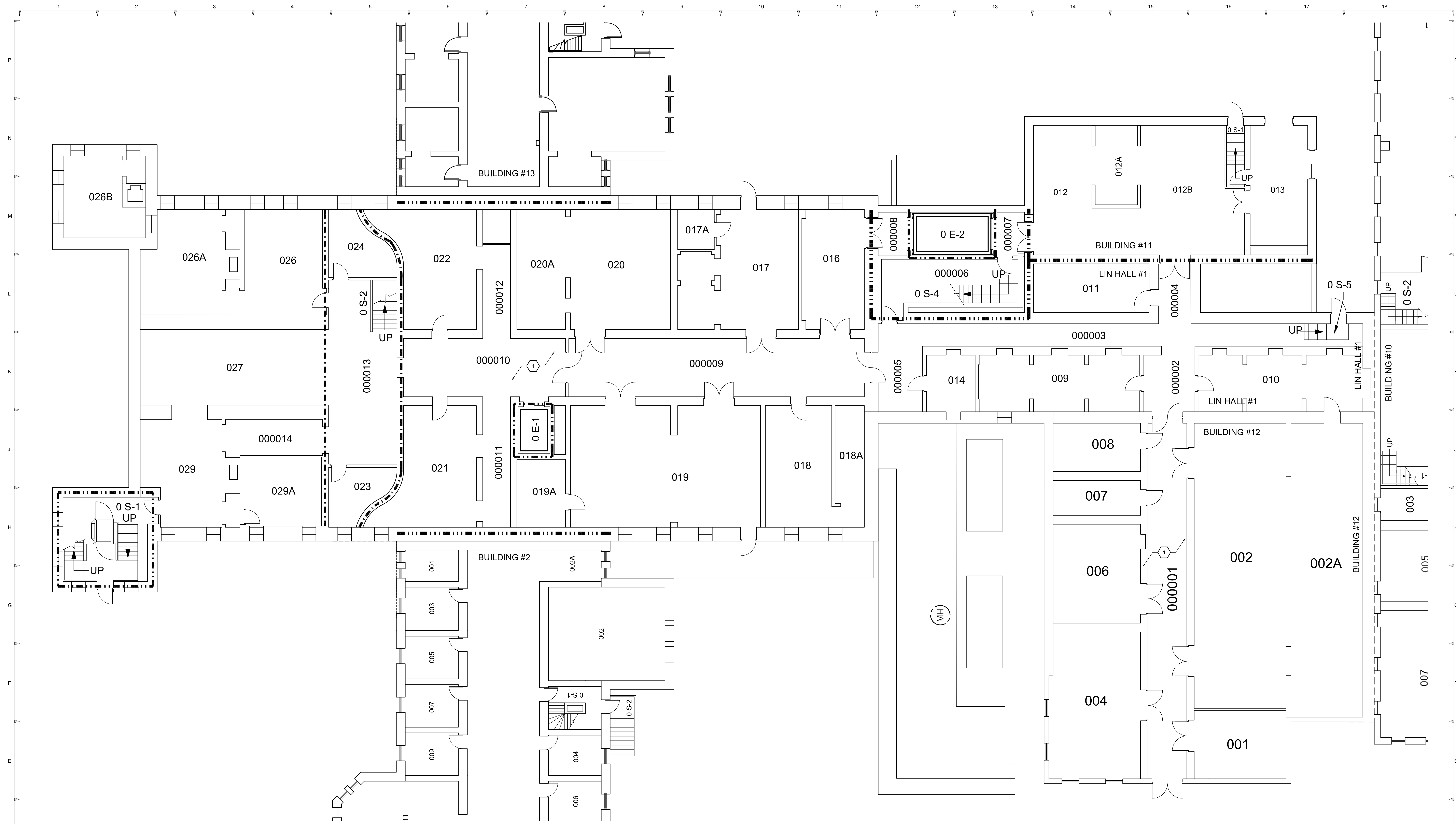
NO.	DATE	DESCRIPTION
07/18/24		REVISION SET
09/09/24		ISSUE FOR REBID

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
DATE: DRAWN:

SHEET TITLE  
**PROJECT INFORMATION**

SHEET  
**G101**



**D5 BASEMENT FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"

**LEGEND**

- · · · — 1 HOUR FIRE WALL
- · · · · — 2 HOUR FIRE WALL
- · · · · · — 3 HOUR FIRE WALL
- · · · · · · — 30 MINUTE SMOKE PARTITION

**LINTEL NOTES:**

1. PROVIDE LINTELS OVER ALL OPENINGS IN MASONRY WALLS.
2. PROVIDE ONE ANGLE FOR EACH 4" OF WALL THICKNESS, AND USE 6" MINIMUM BEARING EACH END. FOR BEAM LINTELS, STOP BOTTOM PLATE 1/8" SHORT OF JAMBS, AND USE 8" MINIMUM BEARING AT EACH END.

MASONRY ROUGH OPENING SECTION	
TO 4'-0"	L 3-1/2" x 3-1/2" x 5/16"
4'-1" TO 5'-6"	L 4" x 3-1/2" x 5/16" LLV
5'-7" TO 6'-6"	L 5" x 3-1/2" x 5/16" LLV
6'-7" TO 8'-0"	L 6" x 3-1/2" x 5/16" LLV
8'-1" TO 10'-0"	W8x18 W/PL 5/16" x (WALL "T"-1/2")
10'-1" TO 12'-0"	W8x21 W/PL 5/16" x (WALL "T"-1/2")

**CODED NOTES:**

1. LIMITED WORK IN THIS AREA. REFER TO MECHANICAL PLANS, COORDINATE INSTALLATION ROUTING AND ELEVATIONS W/ ARCHITECT PRIOR TO INSTALLATION

**GENERAL NOTES:**

1. ADJACENT AREAS TO BE OCCUPIED BY OWNER FROM 10PM-7 DAYS A WEEK. ALL WORK TO BE COMPLETED WITHOUT INTERRUPTION OF OWNER OPERATIONS. AREAS DURING ATYPICAL TIMES WHICH CONTRACTORS SHALL ACCOMMODATE. CONTRACTOR TO COORDINATE WITH OWNER.
2. CONTRACTOR TO PATCH EXISTING FINISHES TO REMAIN AT TERMINATION OF ALL DEMOLITION. PATCH TO INCLUDE ALL REQUIRED FRAMING, FURRING, GYP BOARD, CORNER GUARDS AND FINISH.
3. ALL WORK TO BE FULLY DUST CONTAINED WITH NEGATIVE PRESSURE REQUIREMENTS THROUGHOUT THE PROJECT. CONTRACTOR TO PROVIDE, INSTALL AND REMOVE AT THE COMPLETION OF THE PROJECT DUST BARRIERS AS REQUIRED TO RESTRICT ACCESS INTO THE AREA OF WORK AND PREVENT DUST MIGRATION. PROVIDE ROLLED FILTER MEDIA OVER ALL BUILDING RETURN INTAKES WITHIN SCOPE OF WORK.
4. CONTRACTOR TO BE RESPONSIBLE FOR TRAFFIC DETOURS AND PEDESTRIAN PROTECTIONS THROUGHOUT CONSTRUCTION. DETOUR SIGNAGE TO BE PROVIDED BY OWNER AND LOCATION COORDINATED WITH OWNER.
5. DEMOLITION TO BE COMPLETED IN A SAFE AND SECURE MANNER. MATERIALS TO BE REMOVED FROM SITE AND DISPOSED OF WITHOUT STORING OR ACCUMULATION ON SITE.
6. CONTRACTOR TO RESUSPEND PER NEC REQUIREMENTS ALL ELECTRICAL CONDUIT AND LOW VOLTAGE WIRE THAT IS IN THE WAY OF NEW WORK OR DEMOLITION.
7. BUILDING STRUCTURE TO BE PROTECTED DURING CONSTRUCTION.
8. CONTRACTOR TO MAINTAIN UTILITY CONTINUITY WITHIN DEPARTMENT AND PROVIDE ALL REQUIRED REWORK TO ENSURE UTILITY PROVISION.
9. CONTRACTOR TO COORDINATE FIRE ALARM CONTROL WITH OU LIFE SAFETY SHOP. OU TO MANAGE FIRE ALARM AND DETECTOR OPERATION AS DIRECTED BY CONTRACTOR. CONTRACTOR TO PROTECT ALL FIRE DETECTION HEADS.
10. PROVIDE LINTELS WHERE REQUIRED BY SCHEDULE (SHEET D101) FOR ALL NEW OPENINGS AND HVAC PENETRATIONS THROUGH MASONRY WALLS.
11. CONTRACTOR TO ASSUME THAT LED PAINT IS PRESENT IN THE BUILDING AND PROVIDE CONTROLS DURING CORING OF EXISTING WALLS

**PROFESSIONAL SEAL**

**ISSUE DATES**

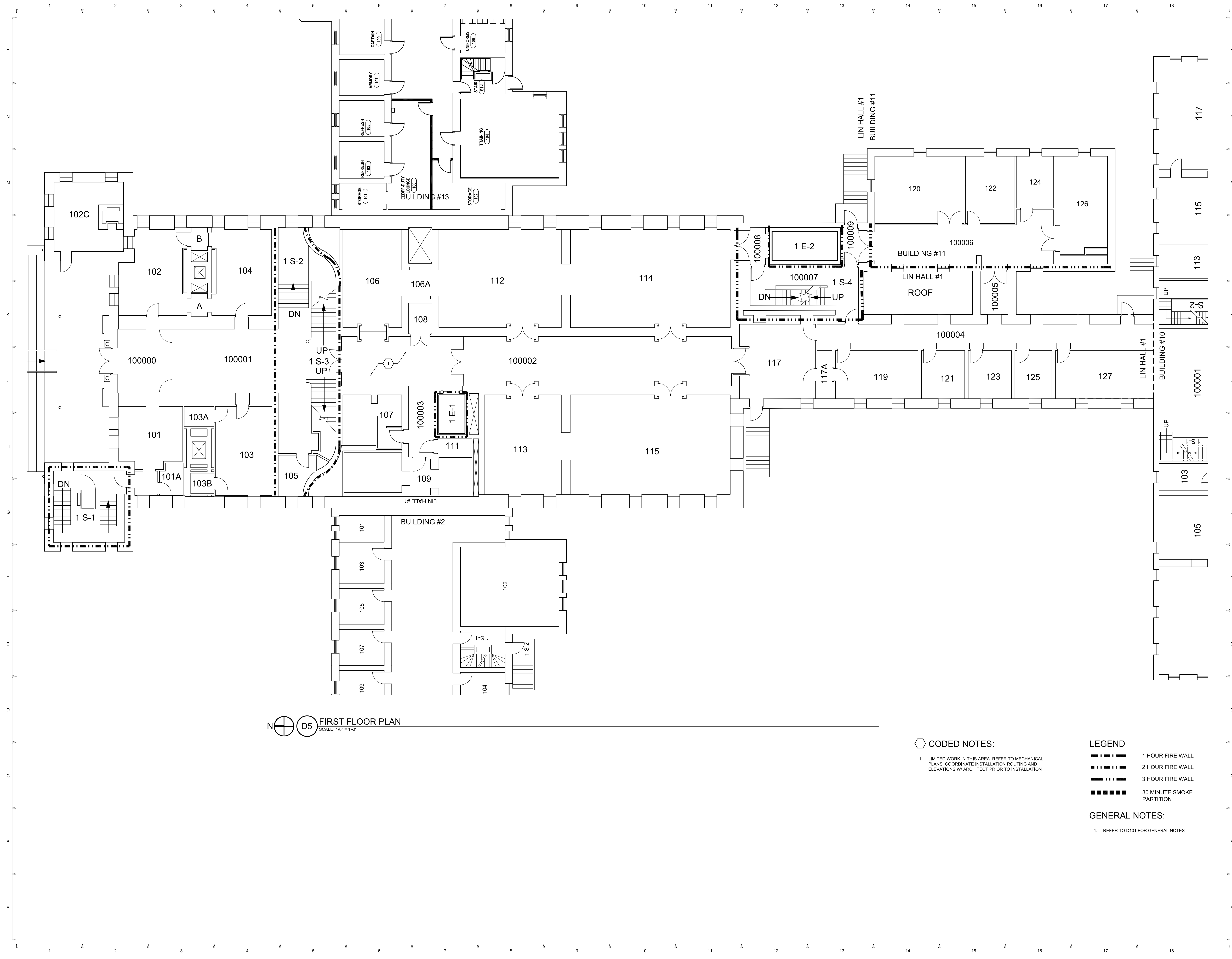
NO.	DATE	DESCRIPTION
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09/09/24		ISSUE FOR REBID

**PROJECT TITLE**  
 OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701

**PROJECT NUMBER** 23002

**SHEET TITLE**  
 BASEMENT PLAN

**SHEET**  
 D101



**FIRST FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"  
 D5

**CODED NOTES:**

- LIMITED WORK IN THIS AREA. REFER TO MECHANICAL PLANS. COORDINATE INSTALLATION ROUTING AND ELEVATIONS W/ ARCHITECT PRIOR TO INSTALLATION

**LEGEND**

- · — · — 1 HOUR FIRE WALL
- · · — · — 2 HOUR FIRE WALL
- · · · — · 3 HOUR FIRE WALL
- · · · · — 30 MINUTE SMOKE PARTITION

**GENERAL NOTES:**

- REFER TO D101 FOR GENERAL NOTES

PROFESSIONAL SEAL

ISSUE DATES

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SHEET TITLE  
 FIRST FLOOR PLAN

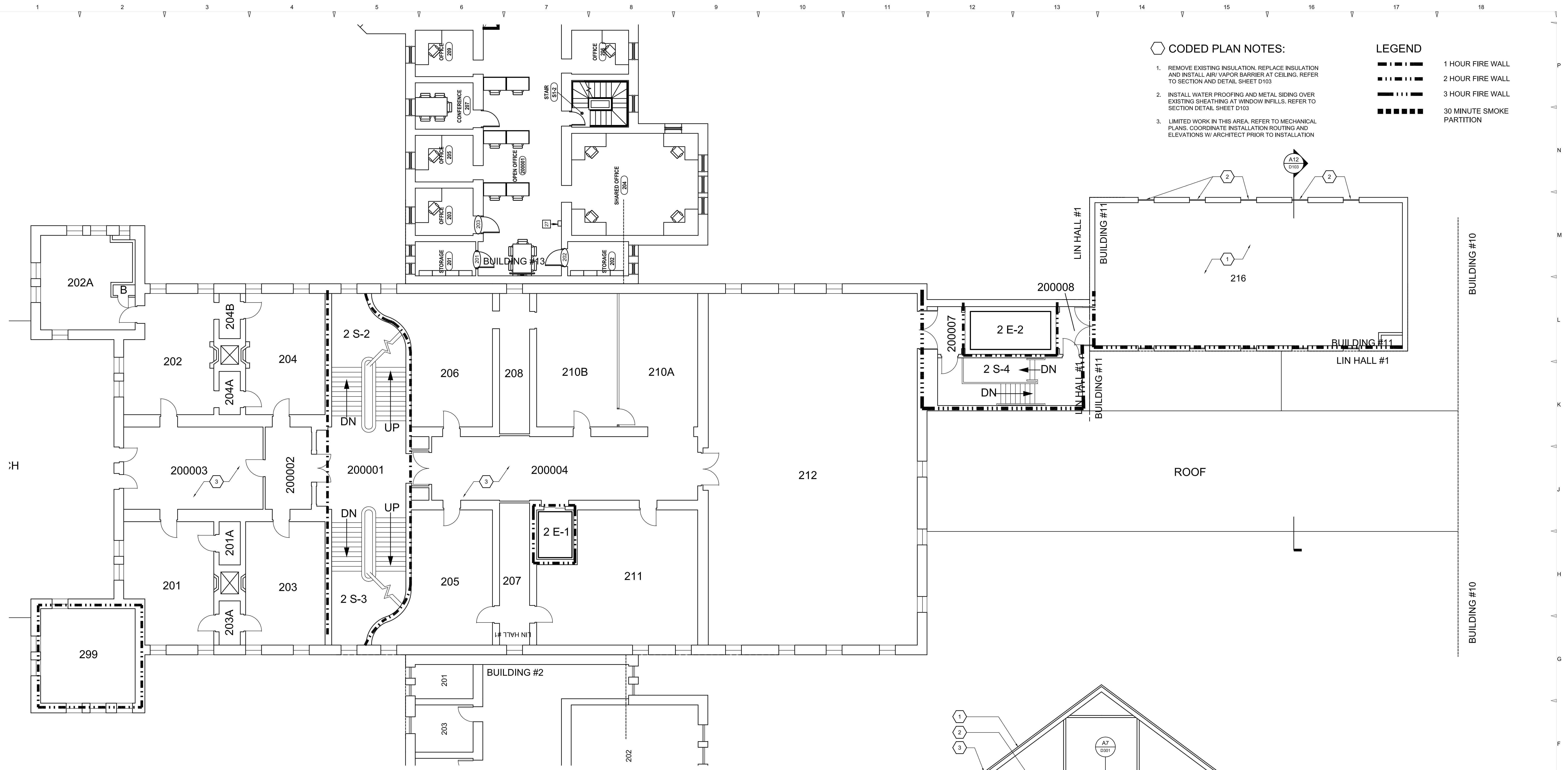
SHEET  
**D102**

**CODED PLAN NOTES:**

1. REMOVE EXISTING INSULATION, REPLACE INSULATION AND INSTALL AIR VAPOR BARRIER AT CEILING. REFER TO SECTION AND DETAIL SHEET D103
2. INSTALL WATER PROOFING AND METAL SIDING OVER EXISTING SHEATHING AT WINDOW INFILLS. REFER TO SECTION DETAIL SHEET D103
3. LIMITED WORK IN THIS AREA. REFER TO MECHANICAL PLANS. COORDINATE INSTALLATION ROUTING AND ELEVATIONS W/ ARCHITECT PRIOR TO INSTALLATION

**LEGEND**

- · — · — · 1 HOUR FIRE WALL
- · — · — · 2 HOUR FIRE WALL
- · — · — · 3 HOUR FIRE WALL
- · — · — · 30 MINUTE SMOKE PARTITION



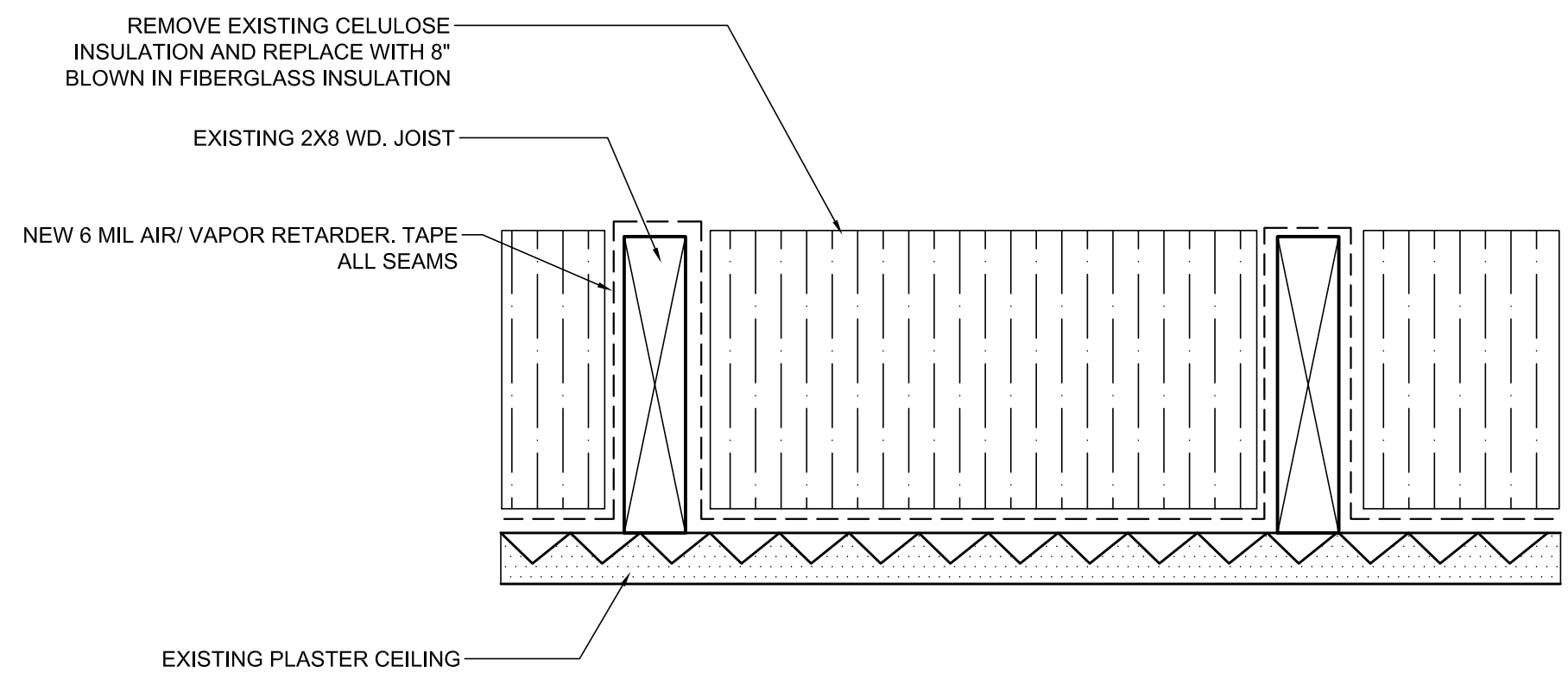
**D5 SECOND FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"

**GENERAL NOTES:**

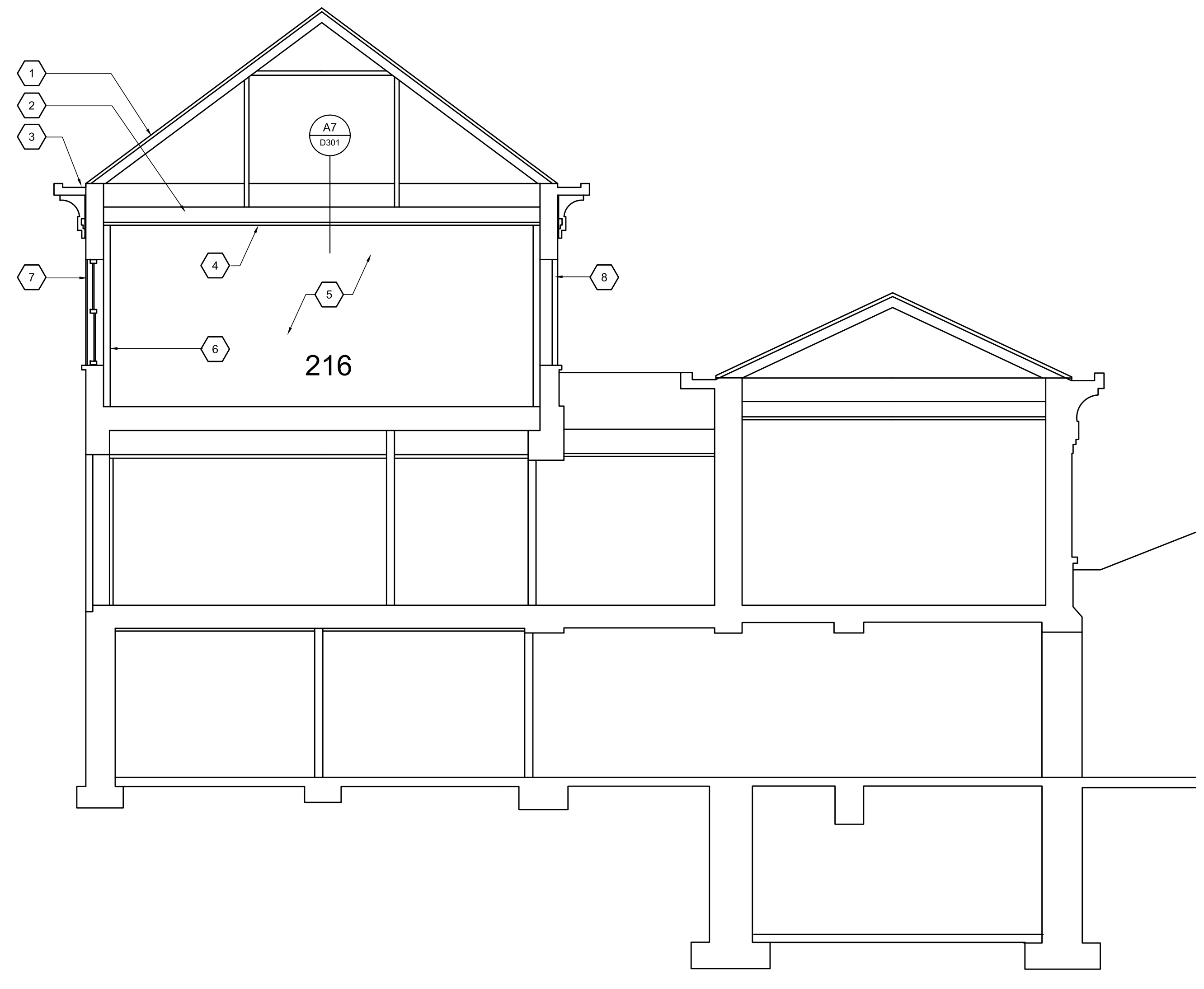
1. REFER TO SHEET D101 FOR TYPICAL GENERAL NOTES

**CODED SECTION NOTES:**

1. EXISTING ASPHALT SHINGLE ROOF OVER WD. SHEATHING TO REMAIN
2. REMOVE EXISTING CELLULOSE INSULATION (+/- 4") INSTALL NEW AIR VAPOR BARRIER AND BLOWN-IN FIBERGLASS INSULATION. REFER TO DETAIL A7/D103
3. EXISTING BOX GUTTER TO REMAIN
4. EXISTING PLASTER CEILING TO REMAIN
5. ARTIFACT STORAGE ROOM
6. EXISTING FURRED WALL TO REMAIN
7. EXISTING PLYWOOD SHEATHING OVER EXISTING WINDOW. COVER SHEATHING WITH PRE-FINISHED 37 GA. CORRUGATED EXPOSED FASTENER METAL SIDING OVER ROLLER APPLIED LIQUID WATER PROOFING/ PRIMER OVER EXISTING SHEATHING. PROVIDE SEALANT AT ALL JOINTS. PROVIDE HEAD AND SILL FLASHINGS WITH HEM AND DRIP
8. EXISTING BRICK INFILL AT OLD WINDOW. ASSEMBLY TO REMAIN



**A7 216 CEILING DETAIL**  
 SCALE: 1/8" = 1'-0"



**A12 BUILDING SECTION**  
 SCALE: 1/8" = 1'-0"

PROFESSIONAL SEAL

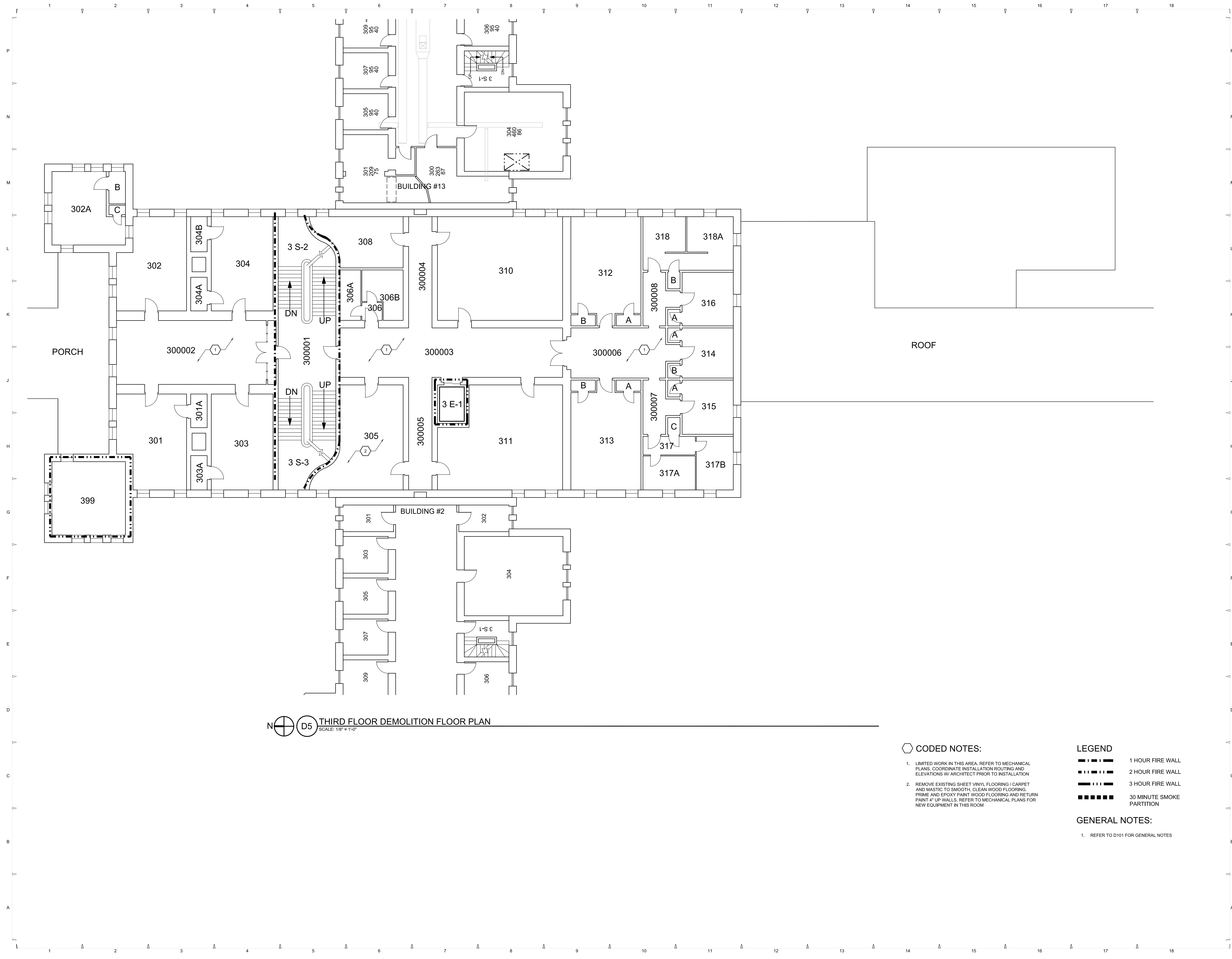
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PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
 DATE: DRAWN:

SHEET TITLE  
**SECOND FLOOR PLAN, SECTION  
 AND DETAIL**

SHEET  
**D103**



**THIRD FLOOR DEMOLITION FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"

**CODED NOTES:**

- LIMITED WORK IN THIS AREA. REFER TO MECHANICAL PLANS, COORDINATE INSTALLATION ROUTING AND ELEVATIONS W/ ARCHITECT PRIOR TO INSTALLATION
- REMOVE EXISTING SHEET VINYL FLOORING / CARPET AND MASTIC TO SMOOTH, CLEAN WOOD FLOORING. PRIME AND EPOXY PAINT WOOD FLOORING AND RETURN PAINT 4" UP WALLS. REFER TO MECHANICAL PLANS FOR NEW EQUIPMENT IN THIS ROOM

**LEGEND**

- 1 HOUR FIRE WALL
- 2 HOUR FIRE WALL
- 3 HOUR FIRE WALL
- 30 MINUTE SMOKE PARTITION

**GENERAL NOTES:**

- REFER TO D101 FOR GENERAL NOTES

PROFESSIONAL SEAL

**ISSUE DATES**

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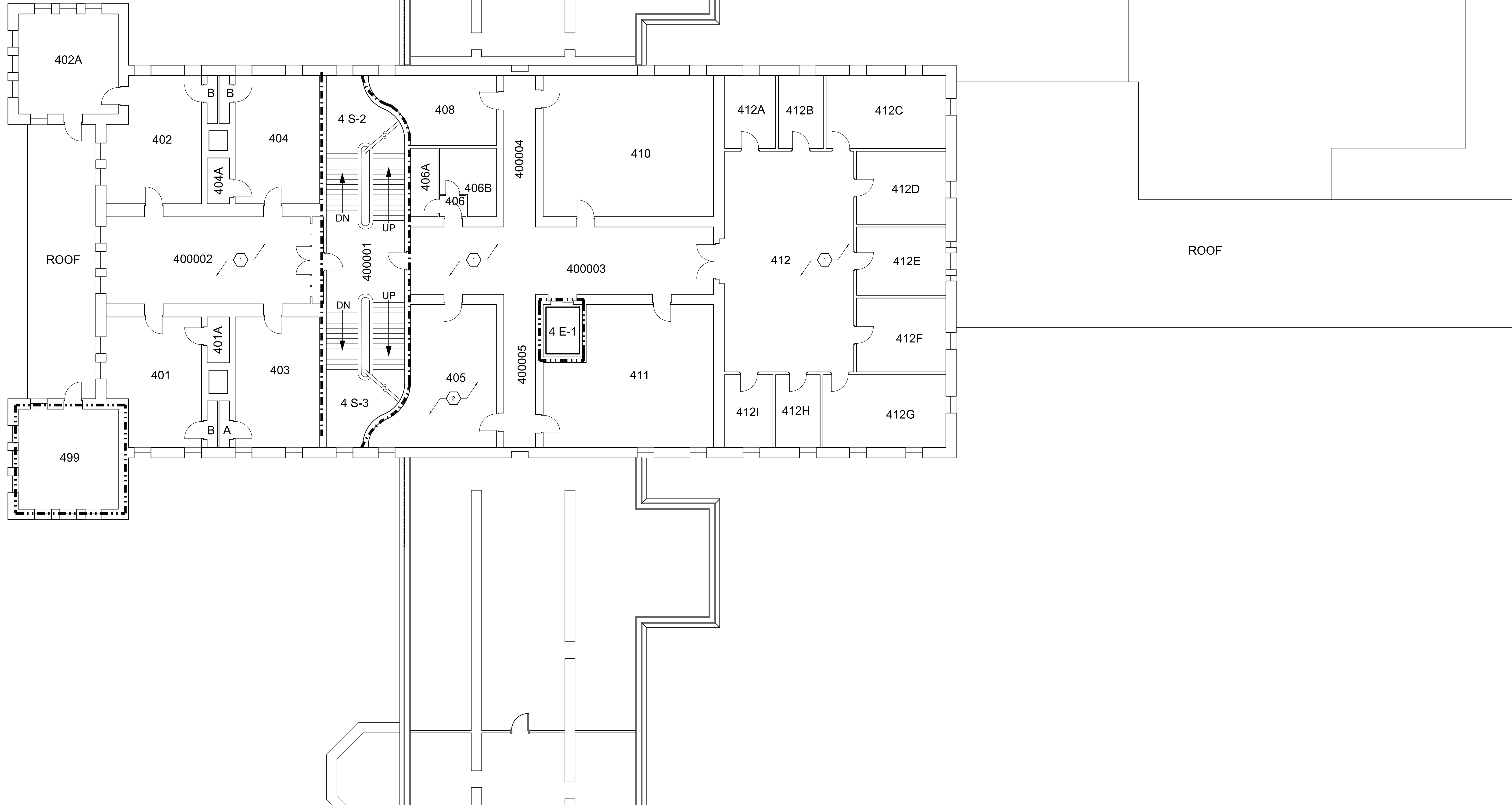
PROJECT NUMBER 23002

DATE DRAWN

**SHEET TITLE**  
 THIRD FLOOR PLAN

**SHEET**  
 D104





**FOURTH FLOOR PLAN**  
 SCALE: 1/8" = 1'-0"  
 D5

**CODED NOTES:**

- LIMITED WORK IN THIS AREA. REFER TO MECHANICAL PLANS. COORDINATE INSTALLATION ROUTING AND ELEVATIONS W/ ARCHITECT PRIOR TO INSTALLATION
- SCRAPE CLEAN AND SAND SMOOTH EXISTING WOOD FLOOR. PRIME AND PAINT WITH EPOXY PAINT.

**LEGEND**

- · — · — 1 HOUR FIRE WALL
- · · — · — 2 HOUR FIRE WALL
- · · · — · 3 HOUR FIRE WALL
- · · · · — 30 MINUTE SMOKE PARTITION

**GENERAL NOTES:**

- REFER TO D101 FOR GENERAL NOTES

PROFESSIONAL SEAL

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01/09/24		BID SET
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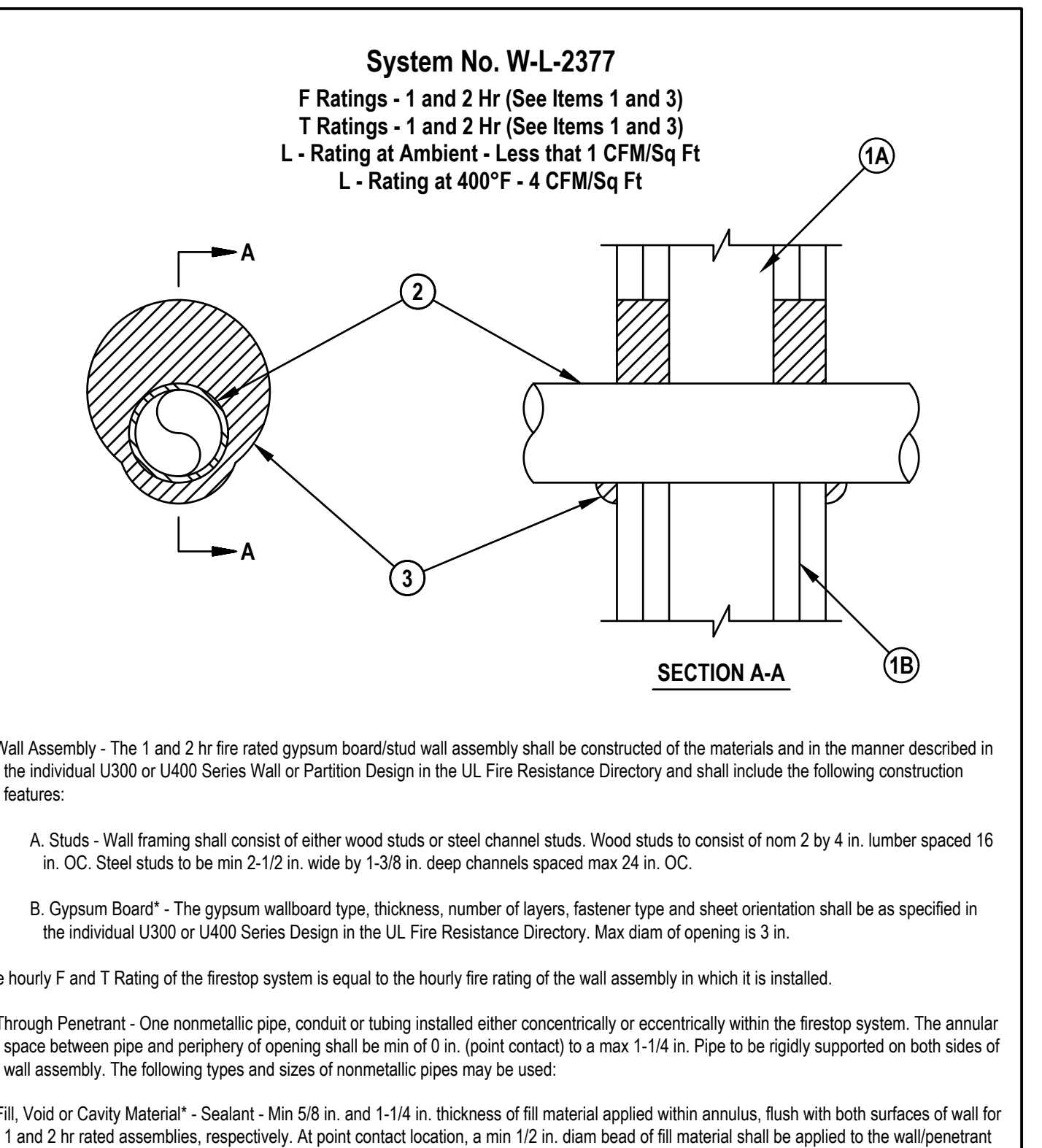
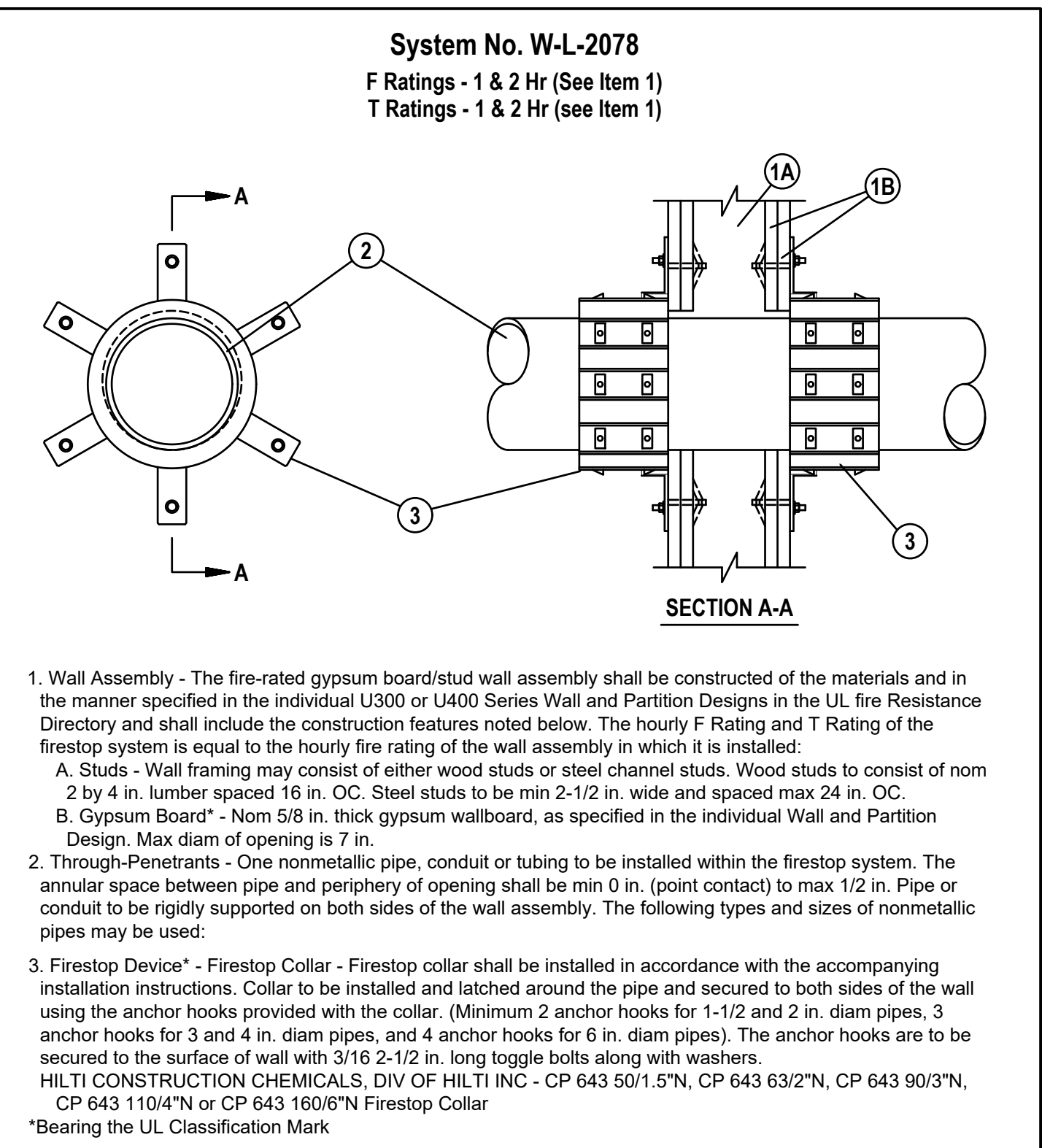
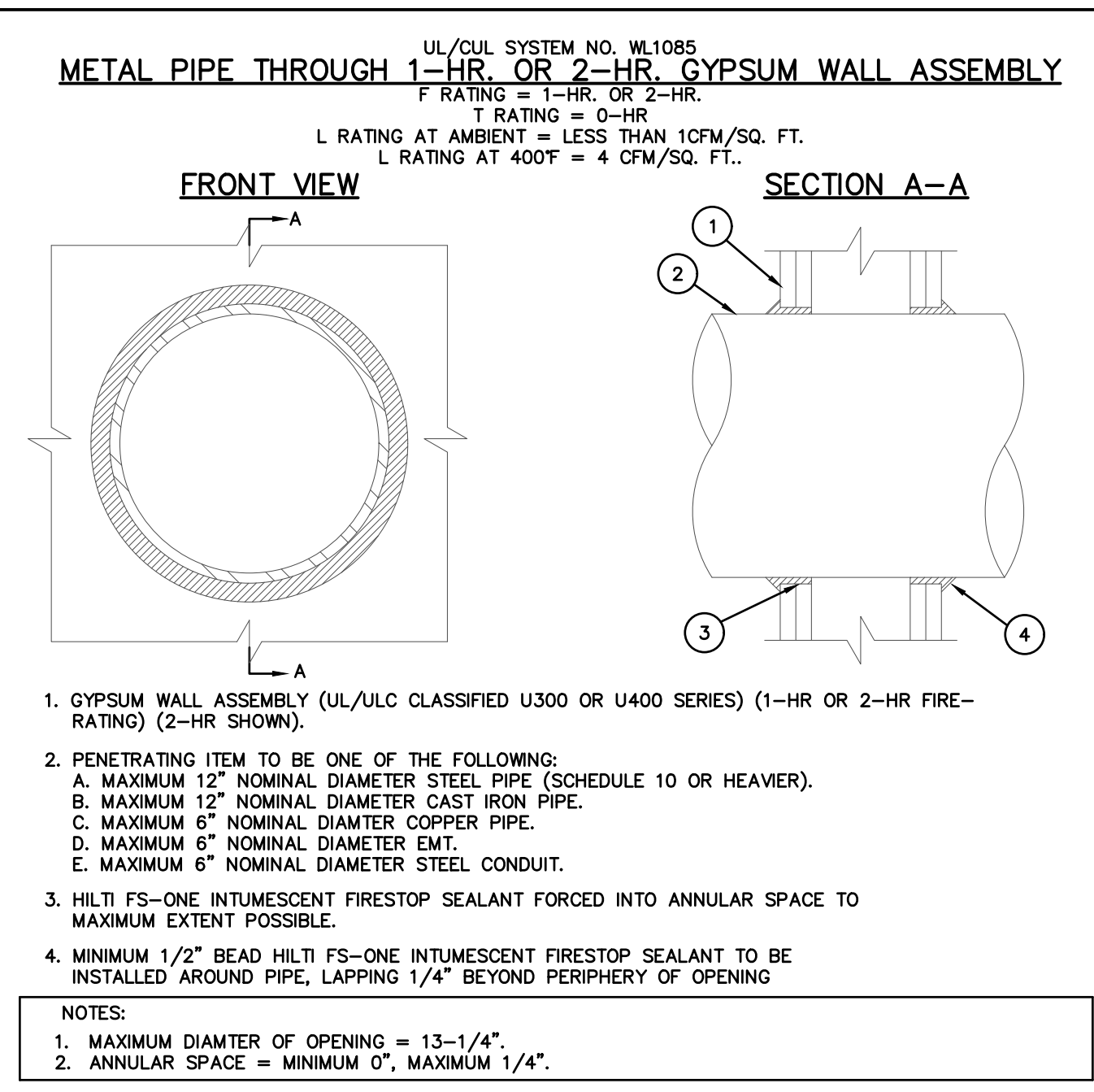
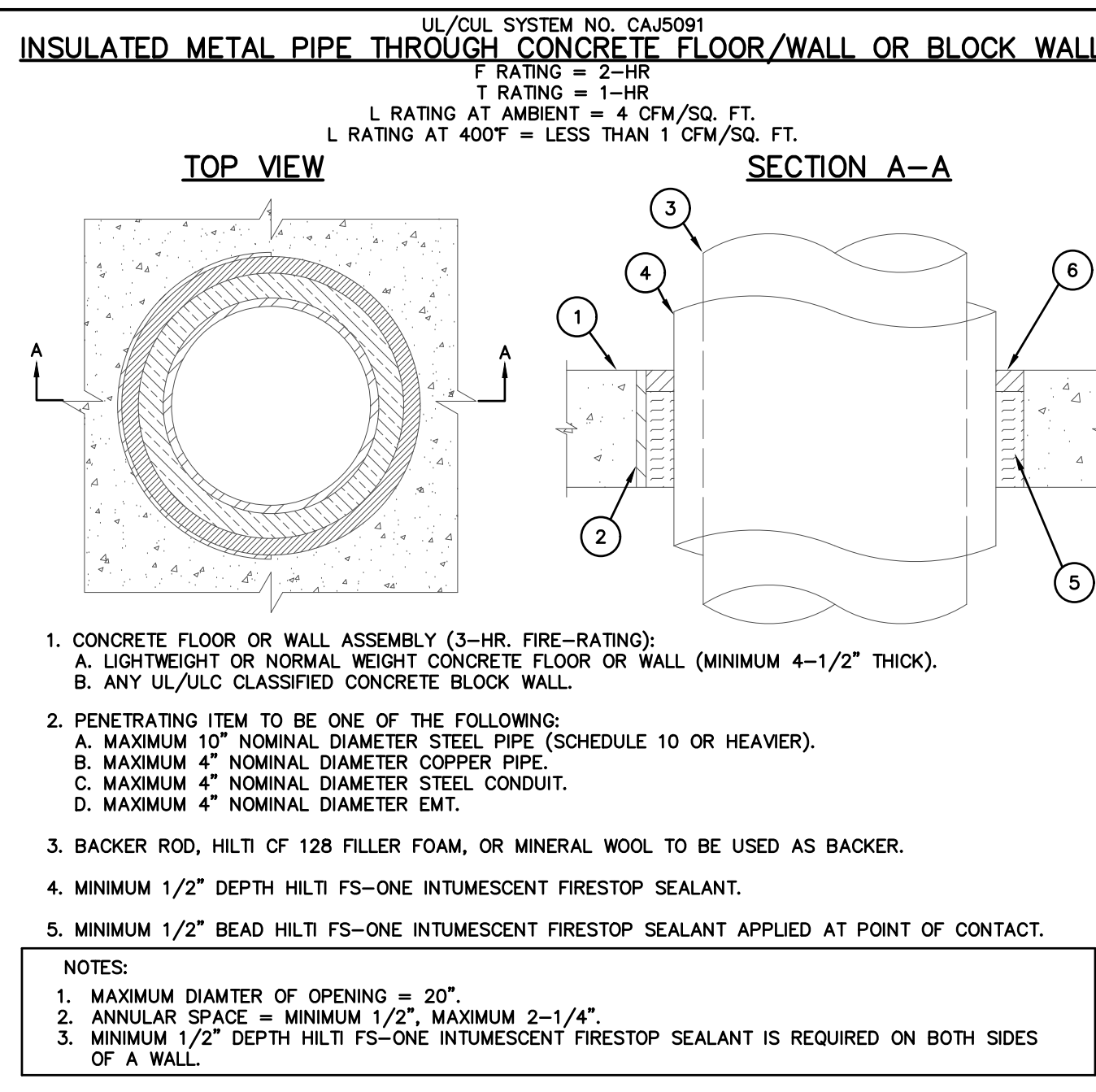
DATE DRAWN

SHEET TITLE  
**FOURTH FLOOR PLAN**

SHEET

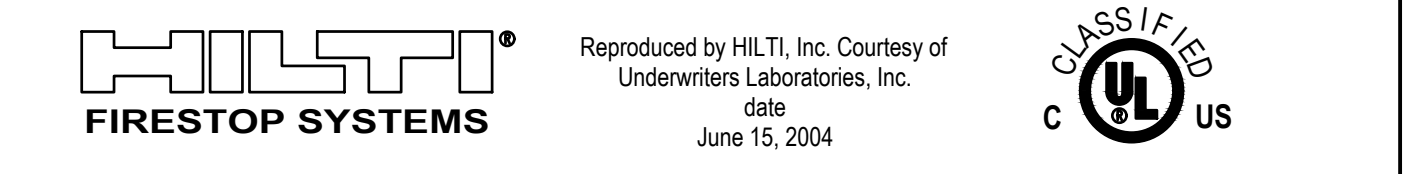
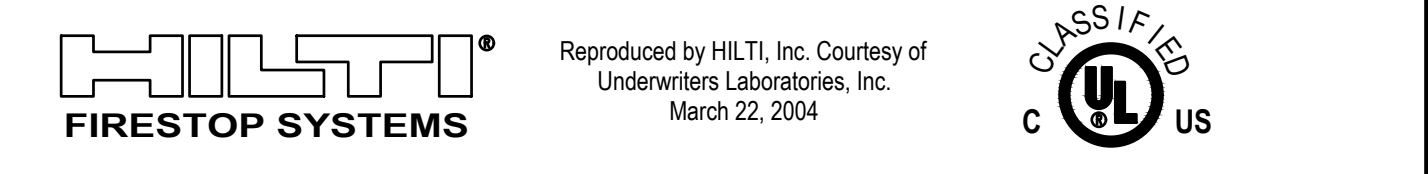
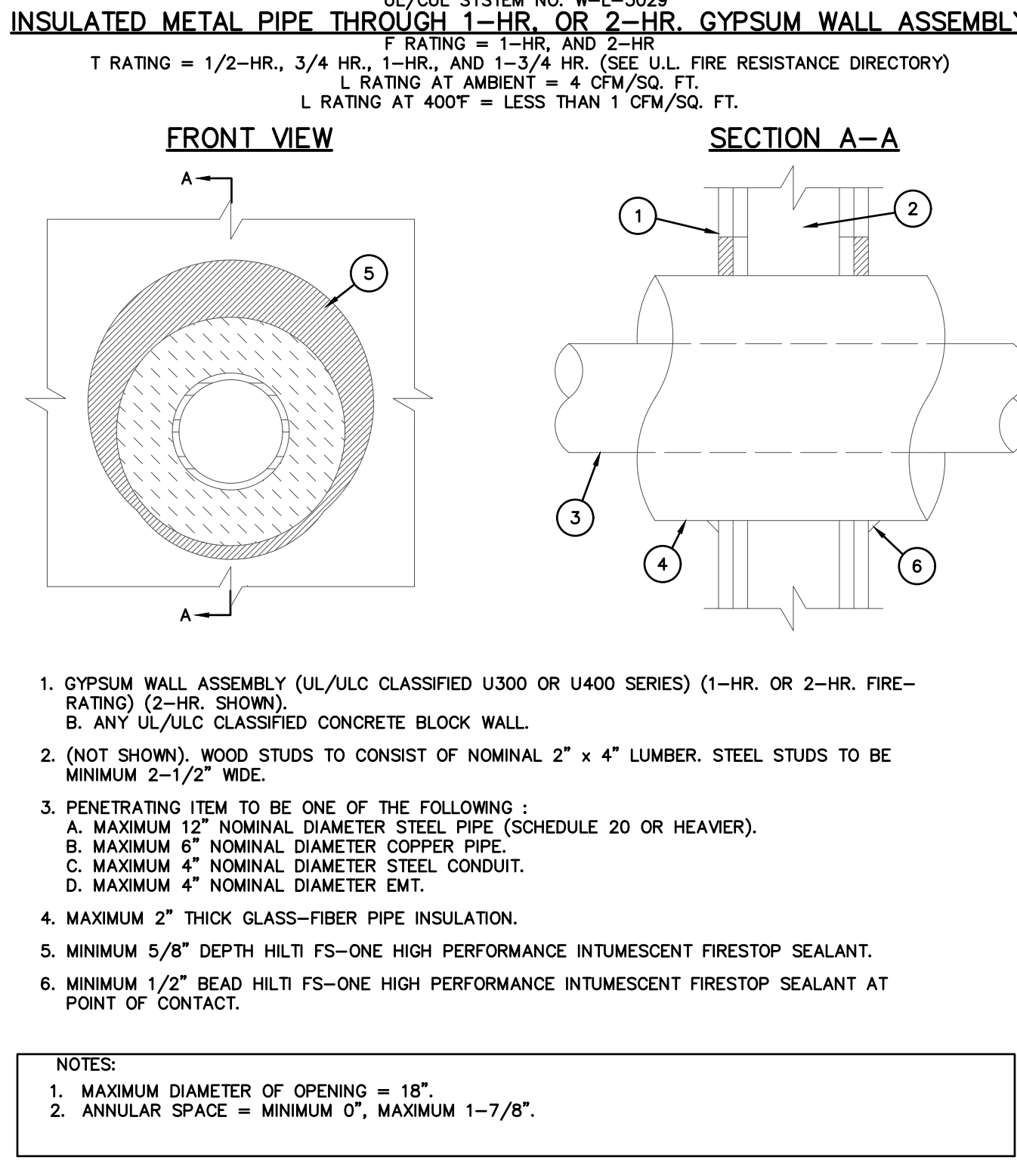
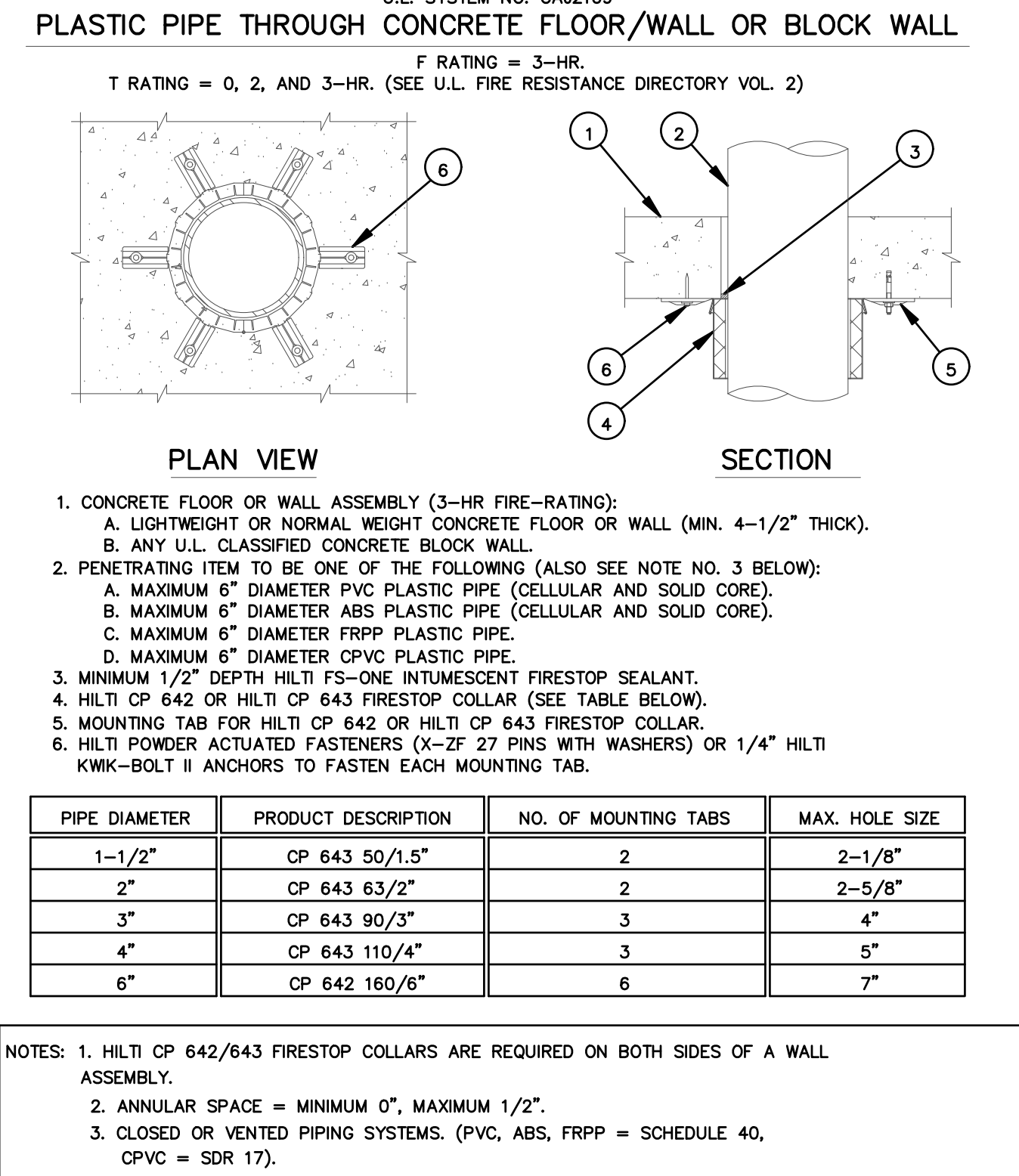
**D105**





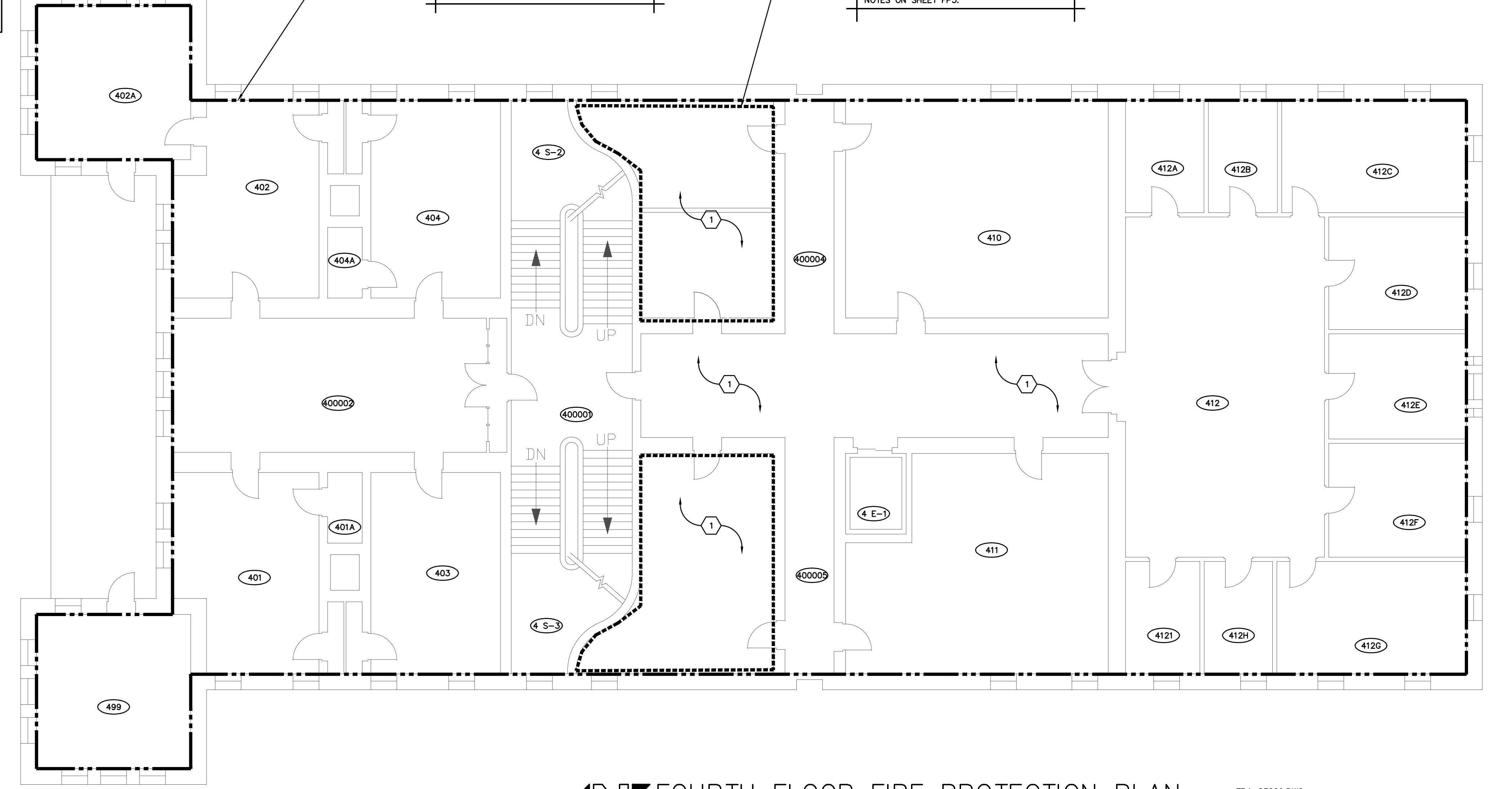
**CODED NOTES**

1. MODIFY/ADD SPRINKLER HEAD LOCATIONS AROUND NEW DUCTWORK/HVAC EQUIPMENT PER NFPA 13 IN THIS AREA.



**SPRINKLER ZONE NOTE:**  
 MODIFY THE EXISTING BUILDING F.P. SPRINKLER INSTALLATION WITHIN THIS SPECIFIC AREA AS REQUIRED BY THE NEW STRUCTURAL, DUCTWORK, AIR DEVICE, AND LIGHTING LAYOUT. THIS INCLUDES, BUT IS NOT LIMITED TO, REVISING, RAISING, AND/OR OFFSETTING EXISTING SPRINKLER PIPING AS REQUIRED BY NEW CEILING FEATURES AND/OR NEW MECHANICAL/ELECTRICAL/PLUMBING ITEMS ABOVE THE NEW CEILING. REMOVING AND REPLACING EXISTING PENDENT HEADS WITH NEW, AND THE COORDINATION OF SPRINKLER HEADS WITH NEW AS WELL AS EXISTING DUCTWORK, AIR DEVICES, LIGHTING, STRUCTURAL MEMBERS, FULL HEIGHT WALLS, AND CEILING FEATURES. PROTECTION/COVERAGE TO BE PER NFPA PAMPHLET 13 LIGHT HAZARD REQUIREMENTS. SEE FIRE PROTECTION NOTES ON SHEET FP3.

**F.P. SPRINKLER SUB-ZONE NOTE:**  
 MODIFY THE EXISTING BUILDING F.P. SPRINKLER INSTALLATION WITHIN THIS SPECIFIC AREA AS REQUIRED BY THE NEW STRUCTURAL, DUCTWORK, AIR DEVICE, AND LIGHTING LAYOUT. THIS INCLUDES, BUT IS NOT LIMITED TO, REVISING, RAISING, AND/OR OFFSETTING EXISTING SPRINKLER PIPING AS REQUIRED BY NEW CEILING FEATURES AND/OR NEW MECHANICAL/ELECTRICAL/PLUMBING ITEMS ABOVE THE NEW CEILING. REMOVING AND REPLACING EXISTING PENDENT HEADS WITH NEW, AND THE COORDINATION OF SPRINKLER HEADS WITH NEW AS WELL AS EXISTING DUCTWORK, AIR DEVICES, LIGHTING, STRUCTURAL MEMBERS, FULL HEIGHT WALLS, AND CEILING FEATURES. PROTECTION/COVERAGE TO BE PER NFPA PAMPHLET 13 ORDINARY HAZARD GROUP 1 REQUIREMENTS. SEE FIRE PROTECTION NOTES ON SHEET FP3.



**FOURTH FLOOR FIRE PROTECTION PLAN**  
 SCALE: 1/8"=1'-0"

FP4-23069.DWG

**PRATER**  
 Engineering Associates, Inc.

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DESIGNED BY M. KOVALCHIK DRAWN BY M. KOVALCHIK CHECKED BY C. ANDERSON JOB NUM 23069

**bdt ARCHITECTS & DESIGNERS**

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PROFESSIONAL SEAL

ISSUE DATES  
 NO. DATE DESCRIPTION  
 9/9/24 ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX**  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701

PROJECT NUMBER 23002  
 DATE 10/31/23  
 SHEET TITLE  
**FOURTH FLOOR**  
 FIRE PROTECTION PLAN

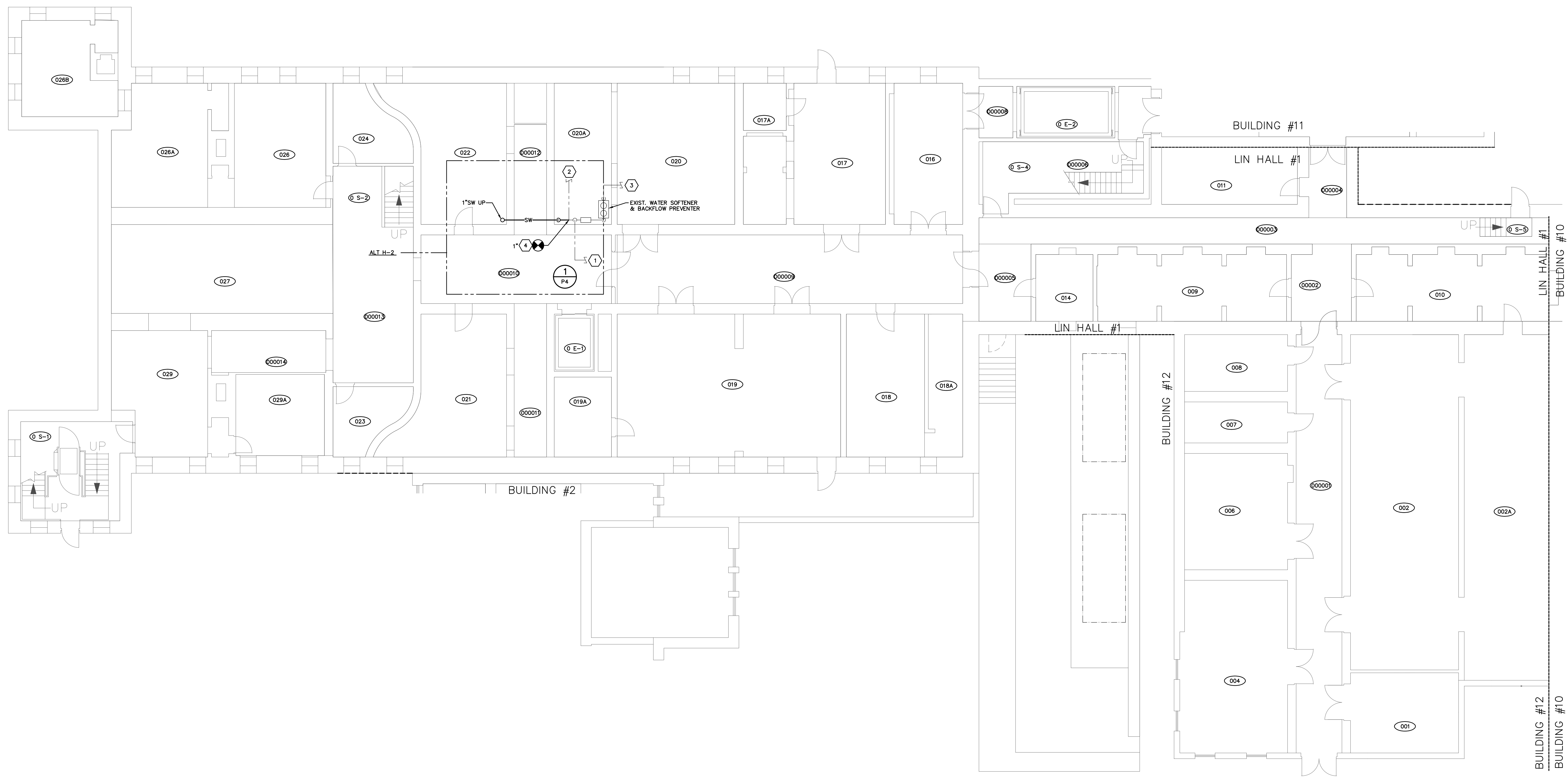
SHEET  
**FP4**

### GENERAL NOTES

- A. FOR SANITARY AND VENT PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO SANITARY ISOMETRIC DRAWING.
- B. FOR WATER PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO WATER RISER DIAGRAM.
- C. MINIMUM SANITARY PIPE SIZE BELOW SLAB/FLOOR SHALL BE 2".
- D. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR EXTENT OF DEMOLITION WORK. COORDINATE WITH SAME.
- E. SWEAT CONNECTION VALVES ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION.
- F. DIELECTRIC UNIONS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- G. PRO-PRESS FITTINGS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- H. CIRCUIT SETTERS SHALL NOT BE USED FOR SHUT OFF. ADDITIONAL SHUT OFF REQUIRED.

### CODED NOTES

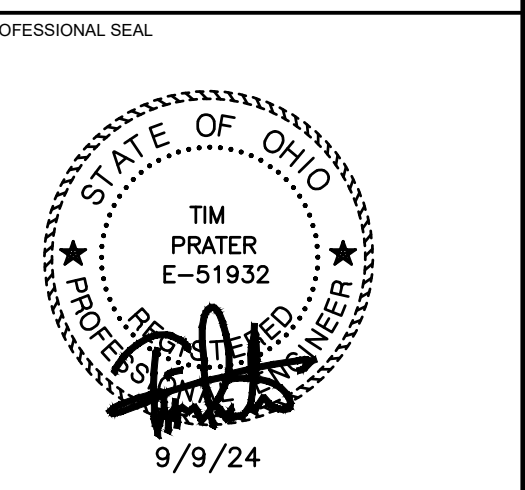
- 1. EXISTING 3/4" SOFTENED WATER TO EXISTING (S) HUMIDIFIERS.
- 2. EXISTING 1" SOFTENED WATER TO EXISTING (S) HUMIDIFIERS.
- 3. EXISTING 1" COLD WATER SUPPLY TO EXISTING WATER SOFTENER.
- 4. CONNECT NEW 1" SOFTENED WATER TO EXISTING 1" SOFTENED WATER PIPING AT THIS APPROXIMATE LOCATION. EXACT LOCATION OF CONNECTION POINT TO BE FIELD VERIFIED/COORDINATED BY THIS CONTRACTOR IN ADVANCE OF WORK.



**BASEMENT PLUMBING PLAN**  
SCALE: 1/8"=1'-0"



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ISSUE DATES

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER 23002  
 DATE 10/31/23 DRAWN

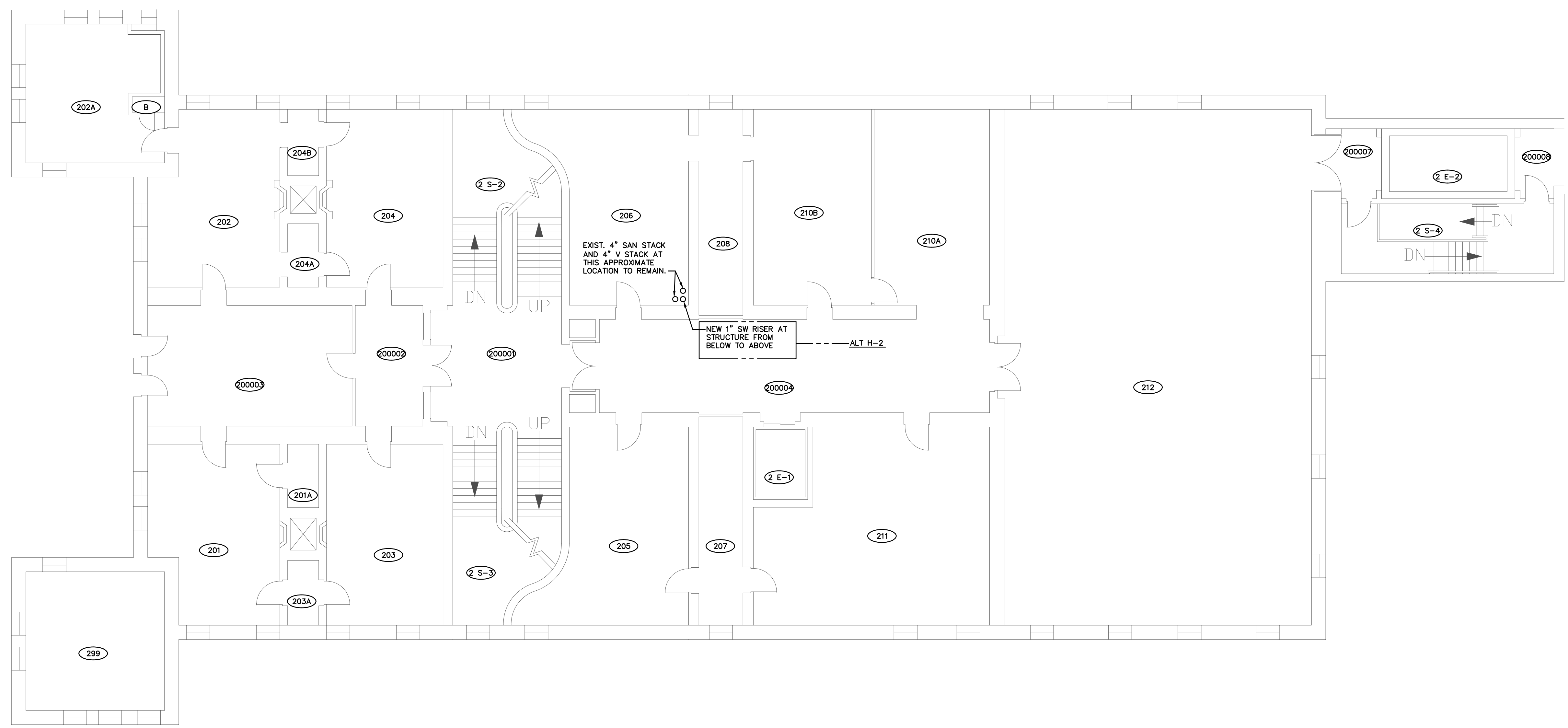
SHEET TITLE  
**BASEMENT  
 PLUMBING PLAN**

SHEET  
**P0**

PO-23069.DWG  
**PRATER**  
**Engineering Associates, Inc.**  
 6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com  
 DESIGNED BY M. KOVALCHIK DRAWN BY M. KOVALCHIK CHECKED BY C. ANDERSON JOB NUM. 23069

**GENERAL NOTES**

- A. FOR SANITARY AND VENT PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO SANITARY ISOMETRIC DRAWING.
- B. FOR WATER PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO WATER RISER DIAGRAM.
- C. MINIMUM SANITARY PIPE SIZE BELOW SLAB/FLOOR SHALL BE 2".
- D. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR EXTENT OF DEMOLITION WORK. COORDINATE WITH SAME.
- E. SWEAT CONNECTION VALVES ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION.
- F. DIELECTRIC UNIONS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- G. PRE-PRESS FITTINGS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- H. CIRCUIT SETTERS SHALL NOT BE USED FOR SHUT OFF. ADDITIONAL SHUT OFF REQUIRED.



**SECOND FLOOR PLUMBING PLAN**  
 SCALE: 1/8"=1'-0"

PROFESSIONAL SEAL

TIM PRATER  
 E-51932  
 9/9/24

ISSUE DATES

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PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER 23002  
 DATE 10/31/23 DRAWN

SHEET TITLE  
**SECOND FLOOR  
 PLUMBING PLAN**

SHEET  
**P2**

P2-23069.DWG

**PRATER**  
 Engineering Associates, Inc.

6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com

DESIGNED BY M. KOVALCHIK	DRAWN BY M. KOVALCHIK	CHECKED BY C. ANDERSON	JOB NUM. 23069
-----------------------------	--------------------------	---------------------------	-------------------

**SHEET P3 DEMOLITION NOTE**

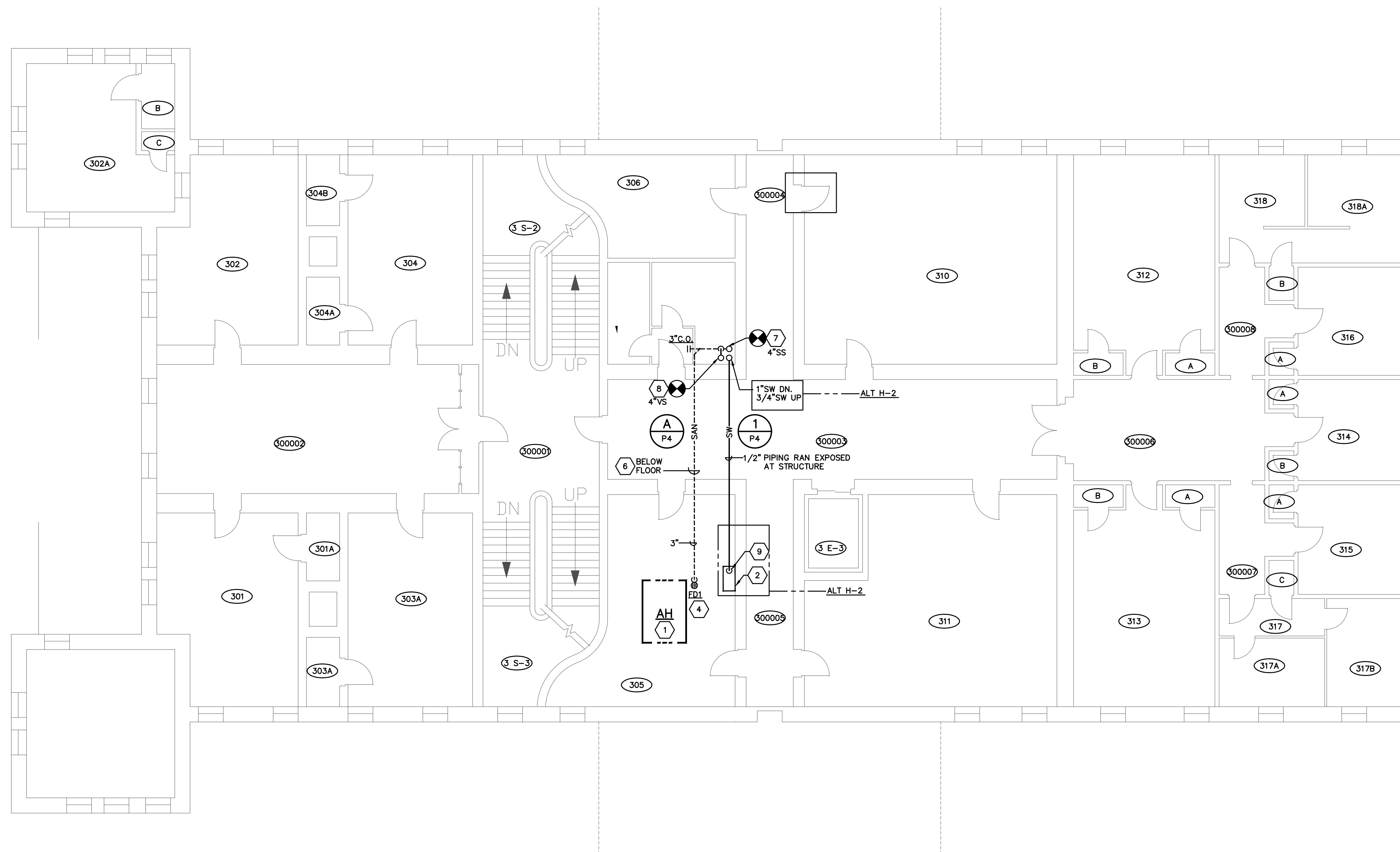
TOTAL FIXTURES TO BE DEMOLISHED:  
 LAVATORIES (2)  
 WATER CLOSETS (1)  
 (FIELD VERIFY EXACT TYPE AND AMOUNT OF FIXTURES TO BE DEMOLISHED)

**GENERAL NOTES**

- A. FOR SANITARY AND VENT PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO SANITARY ISOMETRIC DRAWING.
- B. FOR WATER PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO WATER RISER DIAGRAM.
- C. MINIMUM SANITARY PIPE SIZE BELOW SLAB/FLOOR SHALL BE 2".
- D. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR EXTENT OF DEMOLITION WORK. COORDINATE WITH SAME.
- E. SWEAT CONNECTION VALVES ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION.
- F. DIELECTRIC UNIONS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- G. PRO-PRESS FITTINGS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- H. CIRCUIT SETTERS SHALL NOT BE USED FOR SHUT OFF. ADDITIONAL SHUT OFF REQUIRED.

**CODED NOTES** ☐

1. AIR HANDLER & CONDENSATE DRAINAGE PIPING TO FLOOR DRAIN BY OTHERS.
2. HUMIDIFIER & DRAINAGE PIPING TO FLOOR DRAIN BY OTHERS. INTEGRAL DRAIN WATER TEMPERING SYSTEM & WATER BACKFLOW PREVENTION INCLUDED.
3. INSTALL TRAP PRIMER, TPI, TO PROVIDE FLOOR DRAIN WITH TRAP SEAL PROTECTION. CONNECT TO EXISTING COLD WATER PIPING FROM DEMOLISHED RESTROOM FIXTURES.
4. EXTEND PIPING AFTER TRAP PRIMER TO THIS FLOOR DRAIN.
5. BEFORE START OF NEW WORK, REMOVE ALL EXISTING PLUMBING FIXTURES IN THIS ROOM. CAP EXISTING SANITARY, VENT, COLD WATER, & HOT WATER PIPING IN LOCATION AS TO NOT CONFLICT WITH NEW WORK. COORDINATE WITH OTHER TRADES AND ARCHITECTURAL EXTENTS OF DEMOLITION.
6. COORDINATE WITH EXISTING CONDITIONS AT THE SECOND FLOOR INCLUDING BUT NOT LIMITED TO EXISTING DUCTWORK, AND STRUCTURAL ELEMENTS.
7. CONNECT NEW 4" SAN TO EXISTING 4" SAN STACK BELOW THIS FLOOR AT THE 2ND FLOOR OVERHEAD STRUCTURE AND EXTEND AS SHOWN. PROVIDE TEST TYPE CLEANOUT AT CONNECTION POINT TO EXISTING. EXACT LOCATION OF CONNECTION POINT TO EXISTING TO BE FIELD VERIFIED/COORDINATED BY THIS CONTRACTOR IN ADVANCE OF WORK.
8. CONNECT NEW 2" V TO EXISTING 4" V STACK AT 24" ABOVE FINISHED FLOOR AT THIS APPROXIMATE LOCATION AND EXTEND AS SHOWN. EXACT LOCATION OF CONNECTION POINT TO EXISTING TO BE FIELD VERIFIED/COORDINATED BY THIS CONTRACTOR IN ADVANCE OF WORK.
9. AT THE SOFTENED WATER CONNECTION POINT TO THE HUMIDIFIER, PROVIDE BALL VALVE AND UNION. EXACT LOCATION OF THE INLET CONNECTION POINT TO BE COORDINATED IN-FIELD WITH THE HVAC CONTRACTOR IN ADVANCE OF WORK.



**THIRD FLOOR PLUMBING PLAN**  
 SCALE: 1/8" = 1'-0"

P3-23069.DWG

**PRATER**  
 Engineering Associates, Inc.

6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com

DESIGNED BY M. KOVALCHIK DRAWN BY M. KOVALCHIK CHECKED BY C. ANDERSON JOB NUM. 23069

**bdt** ARCHITECTS & DESIGNERS

601A.D, Inc.  
 26 E. Park Drive, Athens, Ohio 45701  
 OFFICE: 765.592.2422  
 ONLINE: www.bdtad.com  
 EMAIL: office@bdtad.com

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PROFESSIONAL SEAL

STATE OF OHIO  
 PROFESSIONAL ENGINEER  
 TIM PRATER  
 E-51932  
 9/9/24

ISSUE DATES		
NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
 OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701

PROJECT NUMBER 23002  
 DATE 10/31/23 DRAWN

SHEET TITLE  
 THIRD FLOOR  
 PLUMBING PLAN

SHEET  
**P3**

**SHEET P4 DEMOLITION NOTE**

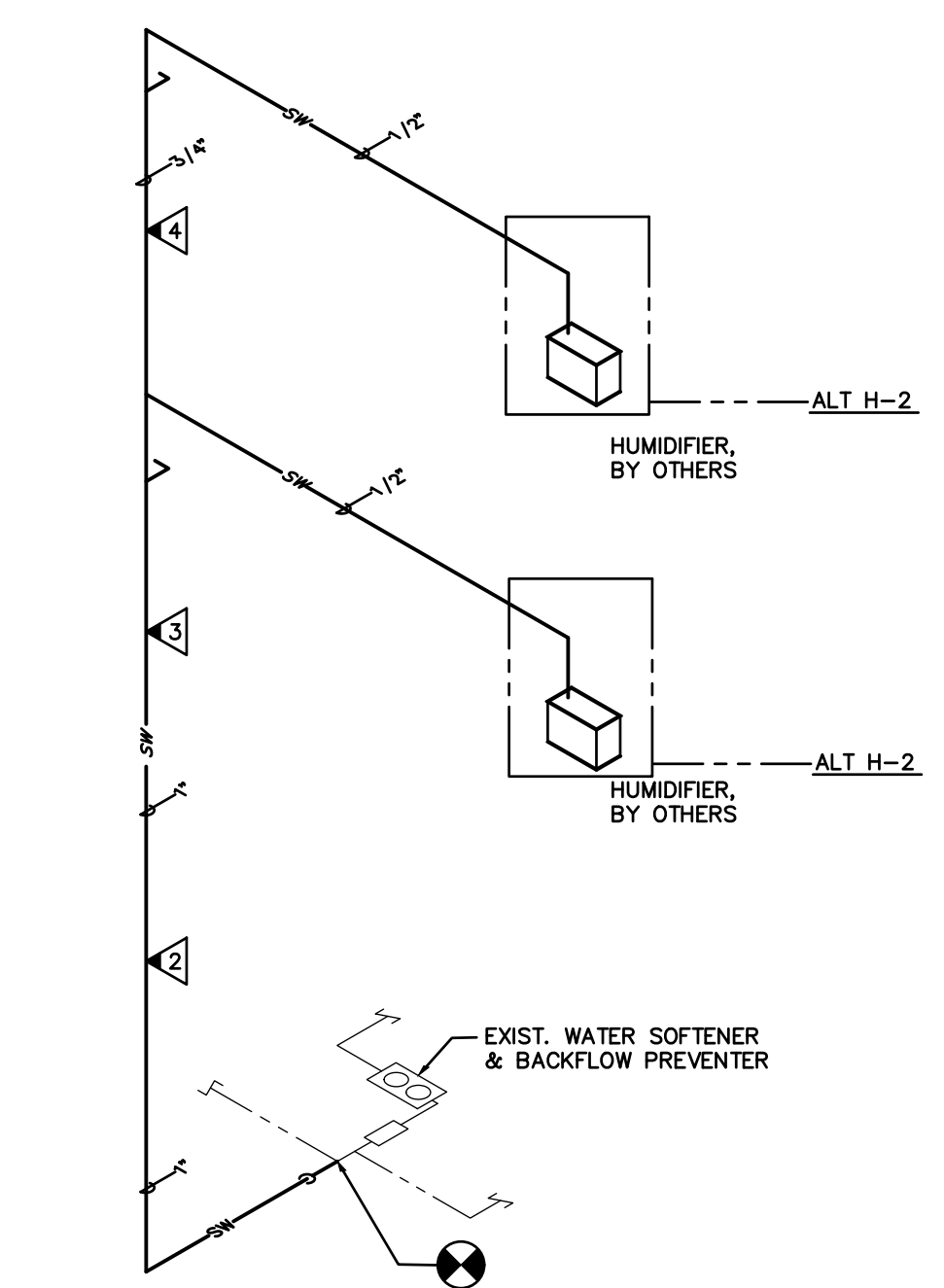
TOTAL FIXTURES TO BE DEMOLISHED:  
 LAVATORIES (2)  
 WATER CLOSETS (1)  
 (FIELD VERIFY EXACT TYPE AND AMOUNT OF FIXTURES TO BE DEMOLISHED)

**GENERAL NOTES**

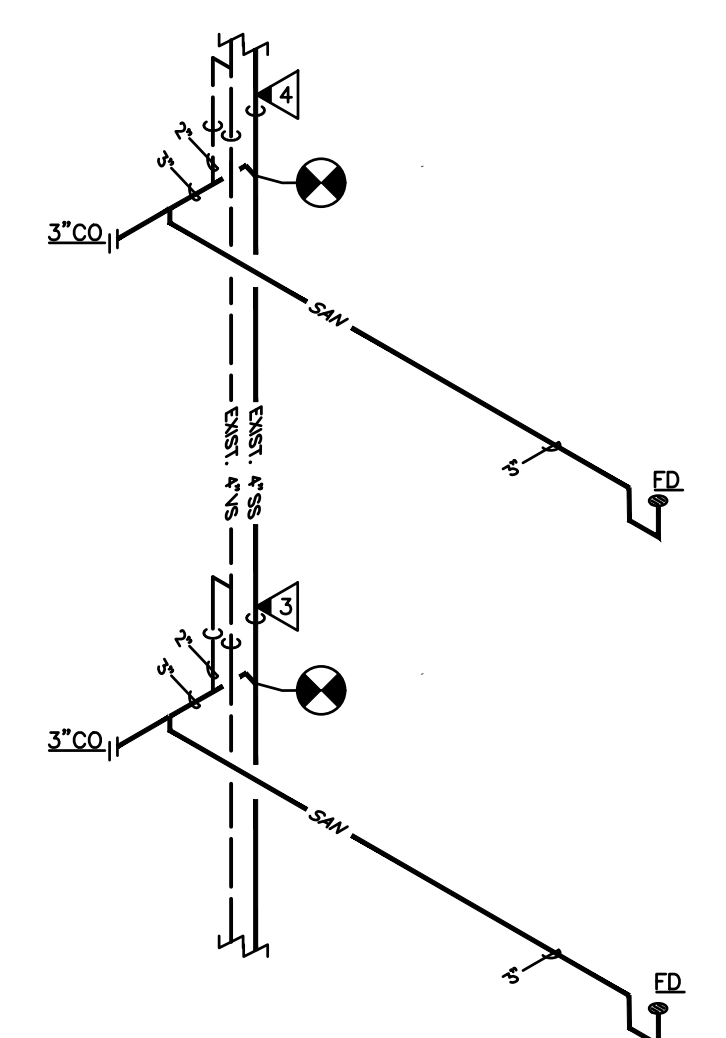
- A. FOR SANITARY AND VENT PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO SANITARY ISOMETRIC DRAWING.
- B. FOR WATER PIPE SIZES NOT SHOWN ON FLOOR PLAN, REFER TO WATER RISER DIAGRAM.
- C. MINIMUM SANITARY PIPE SIZE BELOW SLAB/FLOOR SHALL BE 2".
- D. REFER TO ARCHITECTURAL DEMOLITION PLANS FOR EXTENT OF DEMOLITION WORK. COORDINATE WITH SAME.
- E. SWEAT CONNECTION VALVES ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- F. DIELECTRIC UNIONS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- G. PRO-PRESS FITTINGS ARE PROHIBITED PER DU DESIGN AND CONSTRUCTION STANDARDS.
- H. CIRCUIT SETTERS SHALL NOT BE USED FOR SHUT OFF. ADDITIONAL SHUT OFF REQUIRED.

**CODED NOTES**

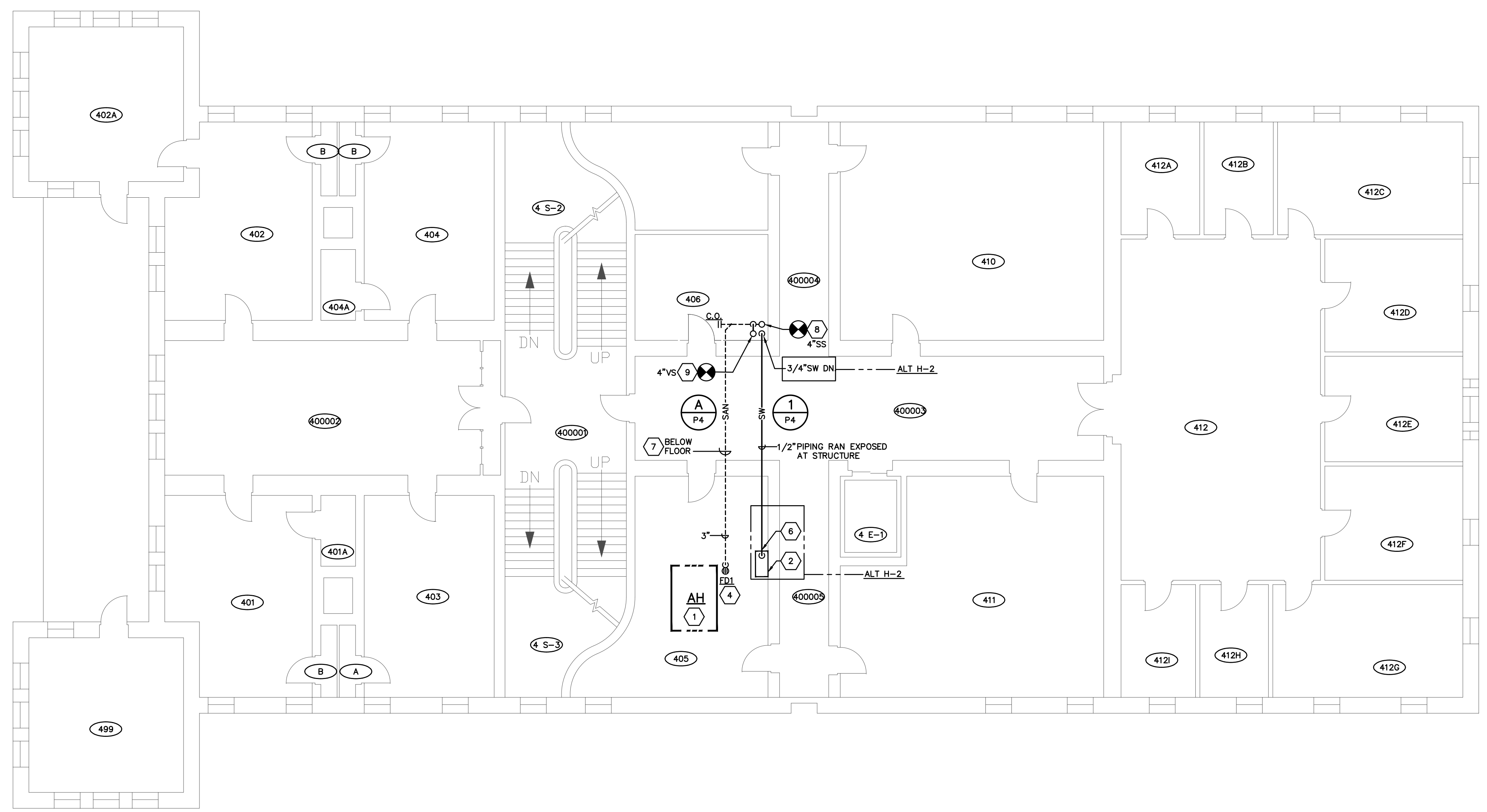
- 1. AIR HANDLER & CONDENSATE DRAINAGE PIPING TO FLOOR DRAIN BY OTHERS.
- 2. HUMIDIFIER & DRAINAGE PIPING TO FLOOR DRAIN BY OTHERS. INTEGRAL DRAIN WATER TEMPERING SYSTEM & WATER BACKFLOW PREVENTION INCLUDED.
- 3. INSTALL TRAP PRIMER, TP1, TO PROVIDE FLOOR DRAIN WITH TRAP SEAL PROTECTION. CONNECT TO EXISTING COLD WATER PIPING FROM DEMOLISHED RESTROOM FIXTURES.
- 4. EXTEND PIPING AFTER TRAP PRIMER TO THIS FLOOR DRAIN.
- 5. BEFORE START OF NEW WORK, REMOVE ALL EXISTING PLUMBING FIXTURES IN THIS ROOM. CAP EXISTING SANITARY, VENT, COLD WATER, & HOT WATER PIPING IN LOCATION AS TO NOT CONFLICT WITH NEW WORK. COORDINATE WITH OTHER TRADES AND ARCHITECTURAL EXTENTS OF DEMOLITION.
- 6. AT THE SOFTENED WATER CONNECTION POINT TO THE HUMIDIFIER, PROVIDE BALL VALVE AND UNION. EXACT LOCATION OF THE INLET CONNECTION POINT TO BE COORDINATED IN-FIELD WITH THE HVAC CONTRACTOR IN ADVANCE OF WORK.
- 7. COORDINATE WITH EXISTING CONDITIONS AT THE THIRD FLOOR INCLUDING BUT NOT LIMITED TO EXISTING DUCTWORK, AND STRUCTURAL ELEMENTS.
- 8. CONNECT NEW 4" SAN TO EXISTING 4" SAN STACK BELOW THIS FLOOR AT THE 3RD FLOOR OVERHEAD STRUCTURE AND EXTEND AS SHOWN. PROVIDE TEST TYPE CLEANOUT AT CONNECTION POINT TO EXISTING. EXACT LOCATION OF CONNECTION POINT TO EXISTING TO BE FIELD VERIFIED/COORDINATED BY THIS CONTRACTOR IN ADVANCE OF WORK.
- 9. CONNECT NEW 2" V TO EXISTING 4" V STACK AT 24" ABOVE FINISHED FLOOR AT THIS APPROXIMATE LOCATION AND EXTEND AS SHOWN. EXACT LOCATION OF CONNECTION POINT TO EXISTING TO BE FIELD VERIFIED/COORDINATED BY THIS CONTRACTOR IN ADVANCE OF WORK.



1 P4 WATER RISER



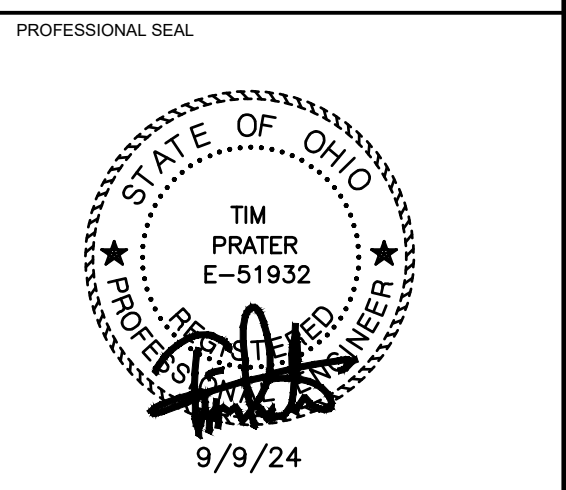
A P4 SANITARY ISOMETRIC



**EN** FOURTH FLOOR PLUMBING PLAN  
 SCALE: 1/8" = 1'-0"



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PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER 23002  
 DATE 10/31/23 DRAWN

SHEET TITLE  
**FOURTH FLOOR  
 PLUMBING PLAN**

SHEET  
**P4**

P4-23069.DWG  
**PRATER**  
 Engineering Associates, Inc.  
 6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com  
 DESIGNED BY M. KOVALCHIK DRAWN BY M. KOVALCHIK CHECKED BY C. ANDERSON JOB NUM. 23069



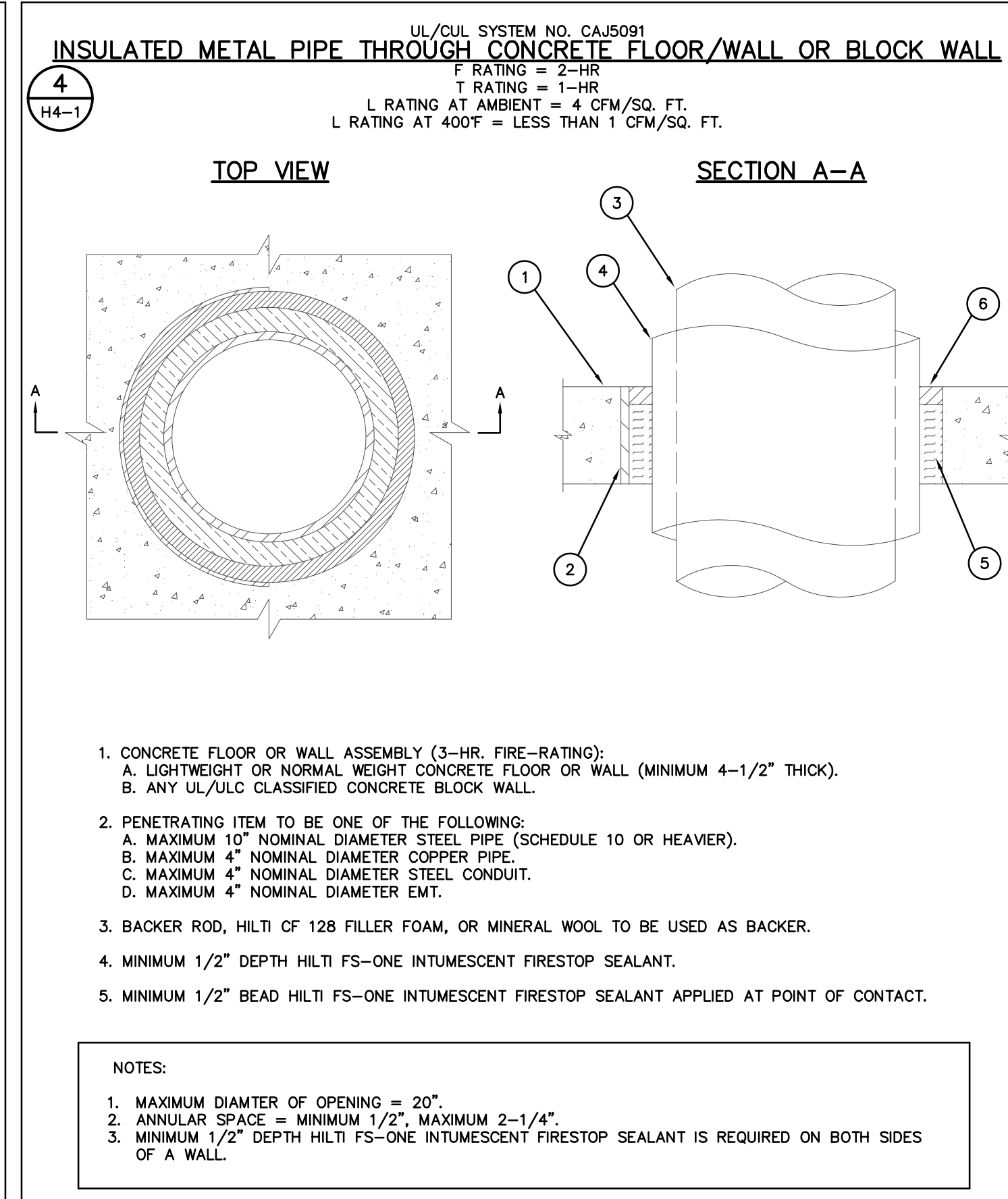
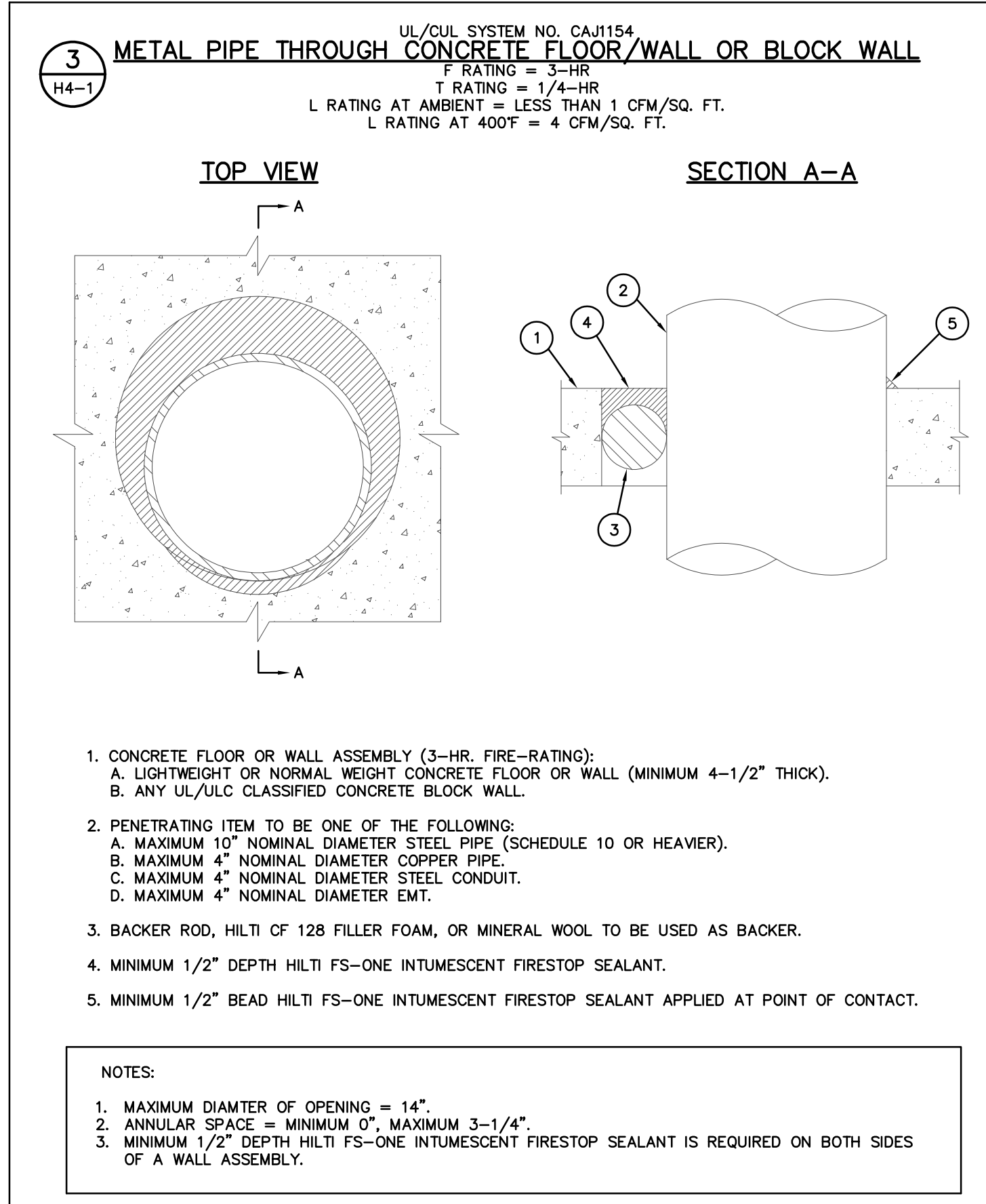


### HVAC ABBREVIATIONS

AB.	ABOVE	HTG.	HEATING
A.D.	ACCESS DOOR	H & A/C	HEATING & AIR CONDITIONING
A.F.F.	ACCESS FINISHED FLOOR	H & C	HEATING & COOLING
AHU	AIR HANDLING UNIT	H & V	HEATING & VENTILATING
APPROX.	APPROXIMATELY	HP	HEAT PUMP
ARCH.	ARCHITECT	H.V.	HIGH VELOCITY
AUTO. CONT.	AUTOMATIC CONTROL	HWP	HEATING WATER PUMP
BSBD, RAD.	BASEBOARD RADIATION	IND. U.	INDUCTION UNIT
BTM.	BOTTOM	MAN. DPR.	MANUAL DAMPER
BLDG.	BUILDING	MFR.	MANUFACTURER
CAB.	CABINET	MCH.	MECHANICAL
CAP.	CAPACITY	M. A.	MIXED AIR
CLG.	CEILING	M.D.	MOUNTED
CONC.	CONCRETE	NOM.	NOMINAL
CONN.	CONNECT	OPNG.	OPENING
CONTR.	CONTRACTOR	O.A.	OUTSIDE AIR
CONT.	CONTINUATION	POHU	POOL DEHUMIDIFICATION UNIT
CONV.	CONNECTOR	PLBG.	PLUMBING
COORD.	COORDINATE	PRES.	PRESSURE
DTL.	DETAIL	P.R.V.	PRESSURE REDUCING VALVE
DIA.	DIAMETER	PROP.	PROPELLER
DIFF.	DIFFUSER	RAD.	RADIATOR
DISCH.	DISCHARGE	REFG.	REFRIGERATION
DOAS	DEDICATED OUTDOOR AIR SYSTEM	REG.	REGISTER
DN.	DOWN	RHC.	REHEAT COIL
EF	EXHAUST FAN	RECD.	REQUIRED
ELEC.	ELECTRICAL	REL.	RELIEF
ELEM.	ELEMENT	R.A.	RETURN AIR
ELEV.	ELEVATION	RM.	ROOM
EXH.	EXHAUST	SCHED.	SCHEDULE
EXIST.	EXISTING	SH/MTL.	SHEET METAL
FT. HD.	FEET OF HEAD	SO.	SQUARE
FIN. RAD.	FINNED RADIATION	STAT.	THERMOSTAT
F & S DPR.	FIRE & SMOKE DAMPER	S.A.	SUPPLY AIR
FLEX.	FLEXIBLE	S & R	SUPPLY & RETURN
F & T	FLOAT & THERMOSTATIC	TEMP.	TEMPERATURE
FLR.	FLOOR	THRM.	THERMOMETER
F.D.	FLOOR DRAIN	TYP.	TYPICAL
FURN.	FURNISH	T.C.C.	TEMP. CONTROL CONTRACTOR
GA.	GAGE	U.H.	UNIT HEATER
GEN.	GENERAL	UV.	UNIT VENTILATOR
GRAV.	GRAVITY	V.	VENTILATION FAN
GR.	GRILLE	VB. ISOL.	VELOCITY ISOLATOR
GWP.	GEOTHERMAL WATER PUMP	W/W	WALL TO WALL
HTR.	HEATER	W/	WITH

### HVAC LEGEND

SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
COND	LOW PRESSURE CONDENSATE	CONCENTRIC REDUCER	
CPD	CONDENSATE PUMP DISCHARGE	EDDENTRIC REDUCER	
CR	CONDENSER WATER RETURN	TIE WITH NIPPLE & CAP	
CWS	CONDENSER WATER SUPPLY	FLUGGED TEE	
CH	DOMESTIC COLD WATER LINE	Y-TYPE STRAINER	
CHWR	CHILLED WATER RETURN	PETE'S FLUG	
CHWS	CHILLED WATER SUPPLY	COMB. BALANCE & STOP VALVE	
DL	DRAIN LINE	BALL VALVE	
HPS	HIGH PRESSURE STEAM	BALL VALVE W/MEMORY STOP	
HWS	HEATING WATER SUPPLY	GATE VALVE (SCREWED BODY)	
HHWR	HEATING WATER RETURN	DRAIN VALVE WITH HOSE END	
R	REFRIGERANT PIPING	GLOBE VALVE	
LPS	LOW PRESSURE STEAM	GATE VALVE (FLANGED BODY)	
OR	RETURN RISER	AUTO CONTROL VALVE	
SR	SUPPLY RISER	SELENID VALVE	
AV	AIR VENT - PLAN VIEW	CHECK VALVE	
EL	EXISTING WORK TO REMAIN	GAS COOK OR BALANCE VALVE	
EW	EXISTING WORK TO BE REMOVED	METERED BALANCE VALVE	
HAHPD	HOT AIR HIGH PRESSURE DUCT	BUTTERFLY VALVE	
CRD	COLD AIR HIGH PRESSURE DUCT	W/MEMORY STOP	
ROR	RISE OR DROP	TEMPERATURE SENSOR	
PBCT	PIPE BRANCH TOP CONNECTION	FLOW SWITCH	
PBCB	PIPE BRANCH BOTTOM CONNECTION	SPACE TEMPERATURE SENSOR	
PA	PIPE ANCHOR	SPACE HUMIDITY SENSOR	
PF	PIPE FLANGES	CO2 SENSOR	
PG	PIPE GLUE	SCHEDULE	
PL	PIPE UNION	THERMOMETER	
PC	FLEXIBLE PIPE CONNECTION	CONNECT TO EXISTING	
FD	FLEXIBLE DUCT	SUPPLY DUCT UP	
SPIN-FIT	SPIN-IN FITTING WITH BALANCE DAMPER	SUPPLY DUCT DOWN	
		R.A., O.A., OR EXH. DUCT UP	
		R.A., O.A., OR EXH. DUCT DOWN	
		ROUND DUCT	
		FLAT OVAL DUCT	
		45° BOOT BRANCH TAKEOFF	
		ELBOW WITH TURNING VANES	
		FIRE DAMPER	
		MAN. DAMPER	
		ACCESS DOOR	



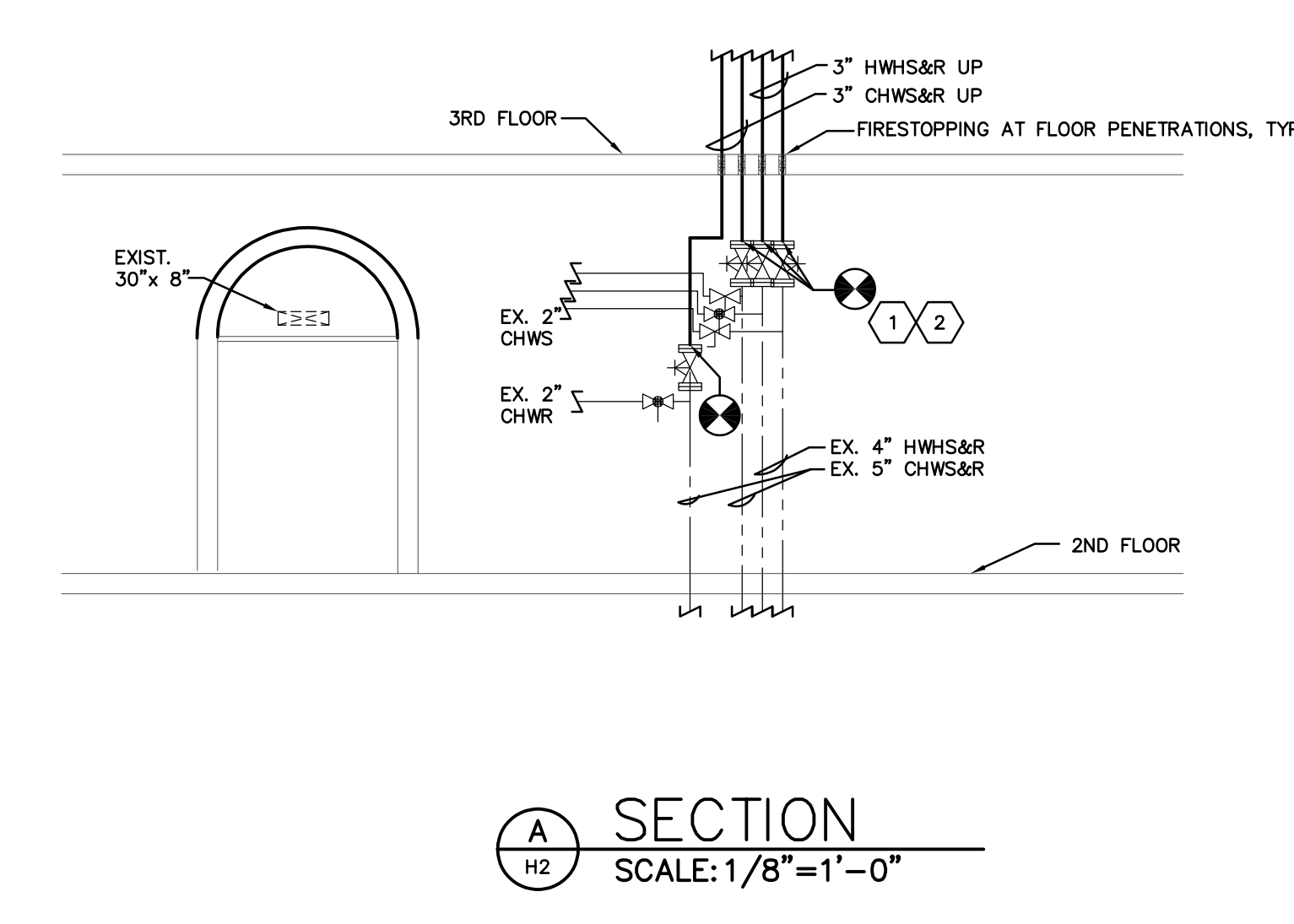
### System No. C-AJ-7051

F Rating = 3 Hr  
T Rating = 1 Hr

**TOP VIEW**      **SECTION A-A**

- Floor or Wall Assembly - Min 4-1/2 in. thick reinforced lightweight or normal weight (100-150 pcf) concrete. Wall may also be constructed of any Underwriters Laboratories Inc. Classified Concrete Blocks. Max area of opening is 1024 in. sq. with a max dimension of 32 in. See Concrete Blocks (CAZT) category in the Fire Resistance Directory for names of manufacturers.
- Steel Duct - Nom 30 by 30 in. (or smaller) No. 24 gauge (or heavier) galv steel duct. One steel duct to be positioned within the firestop system. The annular space shall be min 1/4 in. to a max 1-3/4 in. Duct to be rigidly supported on both sides of floor or wall assembly.
- Firestop System - The firestop system shall consist of the following:  
A. Packing Materials - Min 3-1/2 in. thickness of min 4 pcf mineral wool batt insulation firmly packed into opening as a permanent form between the bare steel duct and the periphery of the opening. Packing material to be recessed from top surface of floor or both surfaces of wall as required to accommodate the required thickness of fill material.  
B. Fill Void or Cavity Material\* - Sealant - Min 1 in. thickness of fill material applied within annulus, flush with top surface of floor or both surfaces of wall.  
C. HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI, INC. - CP606 Flexible Firestop Sealant or FS-ONE Sealant  
D. Steel Retaining Angle - Nom 2 in. by 2 in. by No. 16 gauge (or heavier) steel angles attached to all four sides of the steel duct on the top surface or both surfaces of the wall. The angles shall be attached with No. 8 (or larger) steel sheet metal screws spaced max of 1 in. from each end and a max of 3 in. OC.  
\*Bearing the UL Classification Marking

**HILTI Firestop Systems**      Reproduced by HILTI, Inc. Courtesy of Underwriters Laboratories, Inc. October 20, 2000.



- ### CODED NOTES
- CONNECT TO EXISTING 4" HWS AND HWHR LINES AND RUN 3" LINES UP TO THIRD FLOOR ABOVE.
  - CONNECT TO EXISTING 5" CHILLED WATER LINES AND RUN 3" UP TO THIRD FLOOR.

**bdt ARCHITECTS & DESIGNERS**  
26 E. Park Drive, Athens, Ohio 45701  
OFFICE: 765.660.2400  
ONLINE: www.bdtai.com  
EMAIL: office@bdtai.com

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PROFESSIONAL SEAL  
STATE OF OHIO  
TIM PRATER  
E-51932  
9/9/24

NO.	DATE	DESCRIPTION
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OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701

PROJECT NUMBER 23002  
DATE 10/31/23  
DRAWN

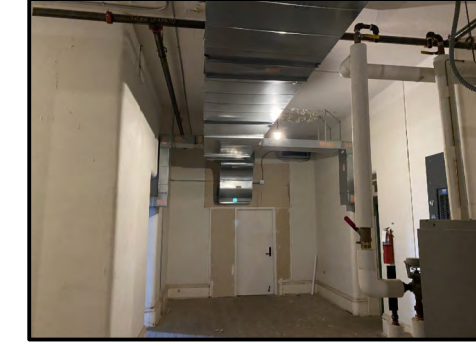
SHEET TITLE  
SECOND FLOOR  
HVAC PLAN

SHEET  
**H2**

H2-23069.DWG  
**PRATER**  
Engineering Associates, Inc.  
6130 Wilcox Road      (614) 766 4896  
Dublin, Ohio 43016      praterengineering.com  
DESIGNED BY B. OGLE      DRAWN BY BHO      CHECKED BY J. LOCKARD, P.E.      JOB NUM. 23069

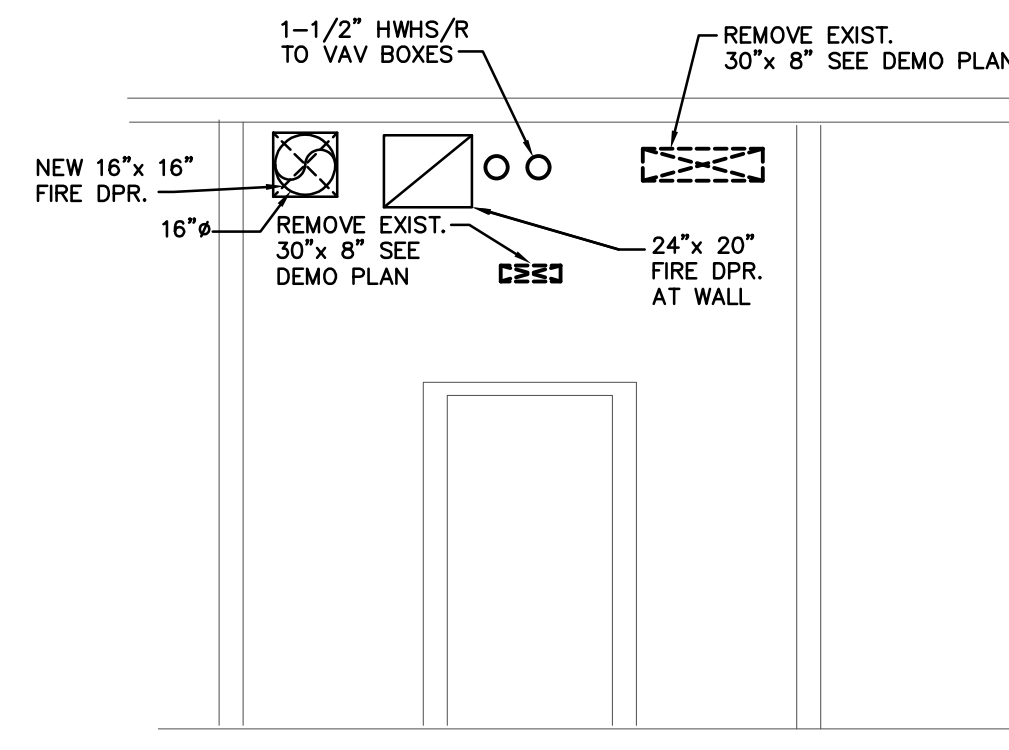


WALL AT MONUMENTAL STAIR  
LOOKING SOUTH (EXIST. PHOTO)



WALL AT MONUMENTAL STAIR  
LOOKING NORTH (EXIST. PHOTO)

EXISTING DUCTWORK AT  
CORRIDOR — SEE DEMO PLAN

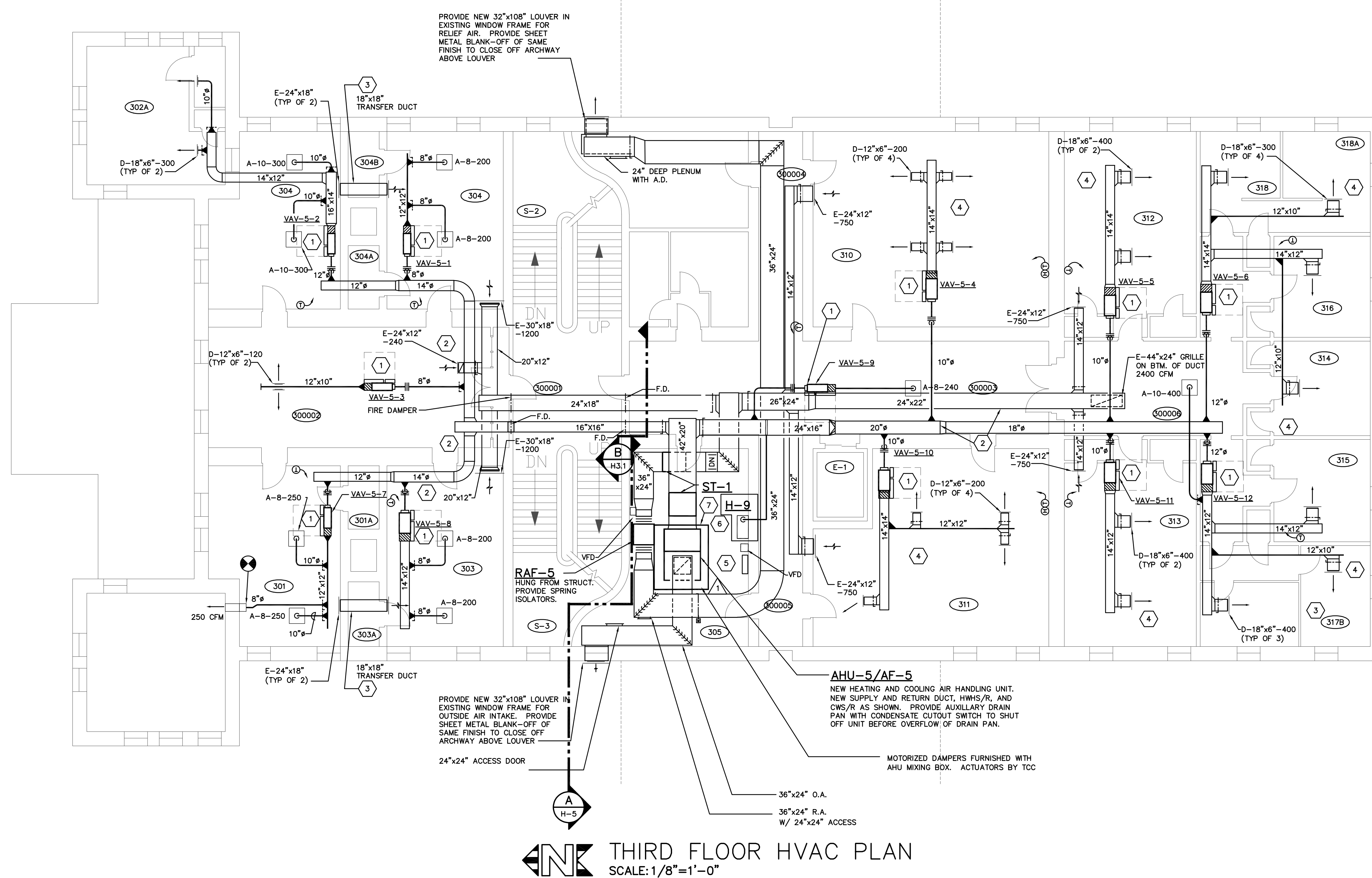


SECTION **B**  
SCALE: 1/4" = 1'-0"  
(TYPICAL NORTH AND SOUTH WALLS OF  
STAIRS FOR THIRD AND FOURTH FLOORS)

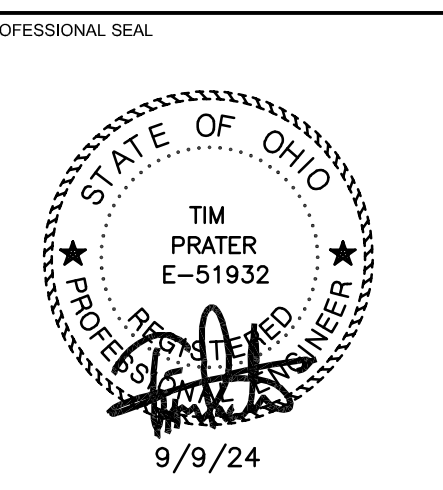
**CODED NOTES**

- BOTTOM OF DUCT AT 10'-0". BOX TO BE ACCESSIBLE FOR MAINTENANCE.
- INSTALL DUCT HIGH IN SPACE WITHIN 1 FT. OF STRUCTURE ABOVE EXCEPT WHERE NEEDED BELOW SPRINKLER LINE.
- TRANSFER DUCT HIGH WITH HIGH SIDEWALL GRILLES. BTM. APPROX. 9'-0" AFF.
- DUCTS IN GALLERY SPACES WITHOUT SUSPENDED CEILINGS TO BE PAINTED BLACK TO BLEND WITH PAINTED SURFACES
- TEMPERATURE CONTROL PANEL.
- UNDER ALTERNATE BID H-2 FURNISH AND INSTALL ELECTRIC HUMIDIFIER H-9, PIPING AND STEAM DISTRIBUTOR FOR GALLERY ZONES. TYPICAL OF 4 UNITS. MOUNT ELECTRIC HUMIDIFIER ON WALL. SUPPLY STEAM PIPING AND DUCT DISTRIBUTOR. SEE EQUIPMENT NOTES AND SCHEMATICS. RUN CONDENSATE TO FLOOR DRAIN.
- FURNISH AND INSTALL A FULL SIZE DRAIN PAN BELOW UNIT AND PIPING. RUN

ALT-H1



**THIRD FLOOR HVAC PLAN**  
SCALE: 1/8" = 1'-0"



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**OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701**

PROJECT NUMBER 23002  
DATE 10/31/23  
DRAWN

SHEET TITLE  
**THIRD FLOOR  
HVAC PLAN**

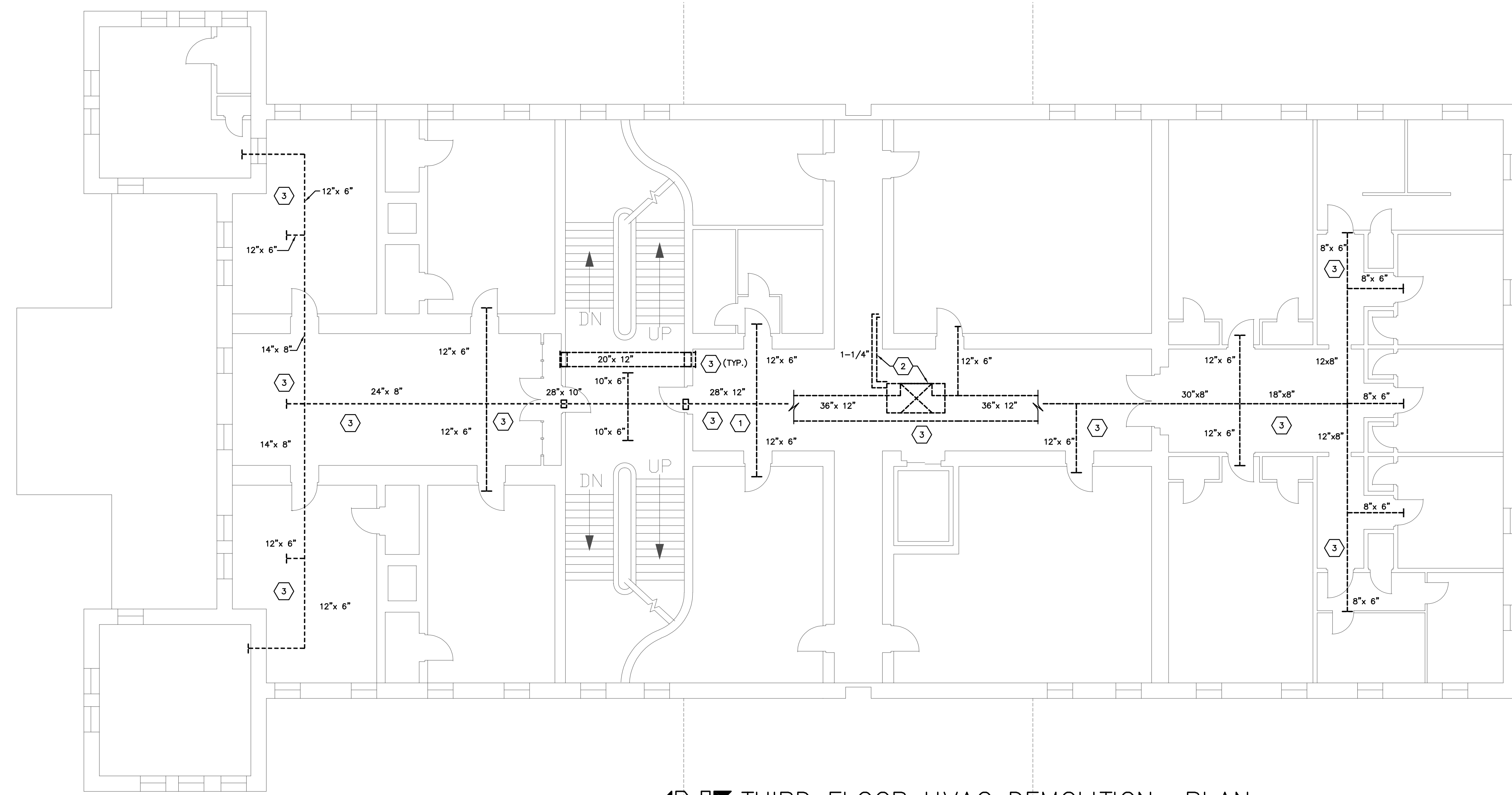
SHEET  
**H3.1**

H3.1-23069.DWG  
**PRATER**  
Engineering Associates, Inc.  
6130 Wilcox Road (614) 766 4896  
Dublin, Ohio 43016 pratereng.com

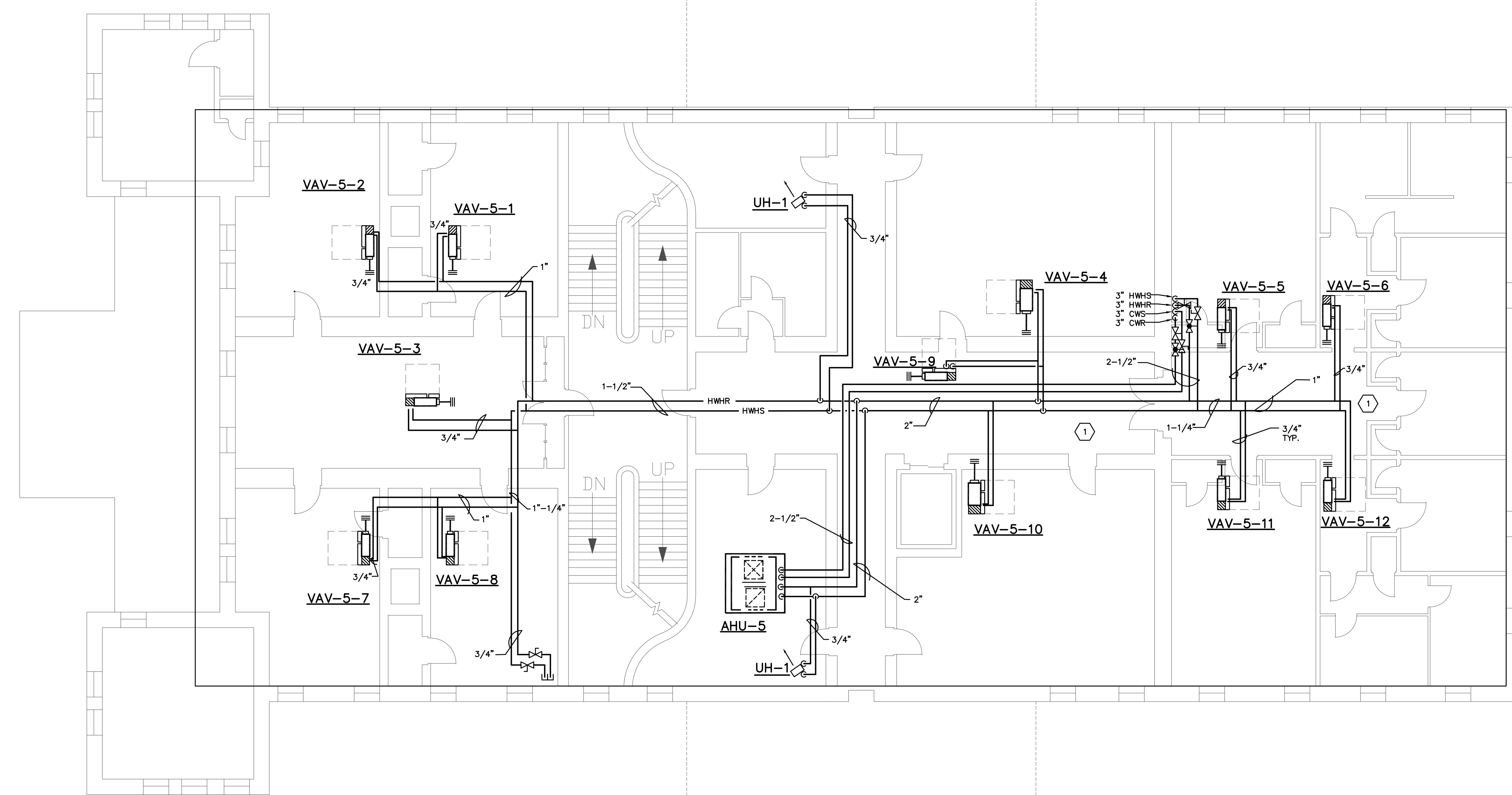
DESIGNED BY B. OGLE	DRAWN BY BHO	CHECKED BY J. LOCKARD, P.E.	JOB NUM. 23069
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**CODED NOTES**

1. PIPING TO RUN BELOW DUCTWORK IN CORRIDORS. RUN AT SAME ELEVATION AS DUCTS WHERE CONNECTING TO VAV TERMINAL REHEAT COILS.
2. REMOVE EXISTING HEATING ONLY AIR HANDLING UNIT AH-5 SYSTEM. DISCONNECT AND REMOVE HEATING WATER SUPPLY AND RETURN LINES BACK TO RISER AND CAP.
3. REMOVE EXISTING UNINSULATED DUCTWORK AND HANGERS, FIRE DAMPERS, FIRE/SMOKE DAMPERS, GRILLES, ACCESSORIES. PATCH OPENINGS TO MATCH EXISTING WALL MATERIAL/RATING



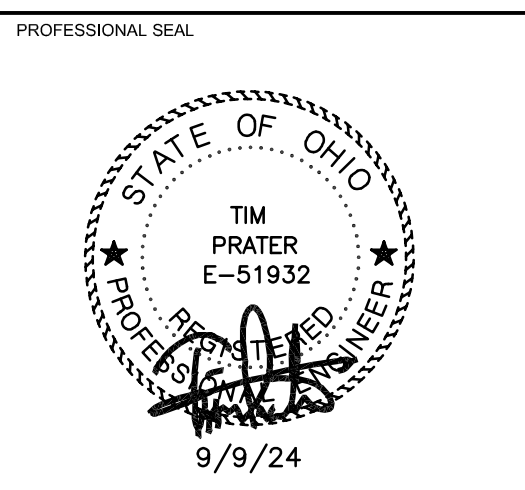
**THIRD FLOOR HVAC DEMOLITION PLAN**  
SCALE: 1/8"=1'-0"



**THIRD FLOOR HVAC PIPING PLAN**  
SCALE: 1/8"=1'-0"



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ISSUE DATES		
NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
DATE: 10/31/23  
DRAWN:

SHEET TITLE  
**THIRD FLOOR HVAC DEMO  
AND HVAC NEW PIPING PLAN**

SHEET  
**H3.2**

H3.2-23006.DWG

**PRATER**  
Engineering Associates, Inc.

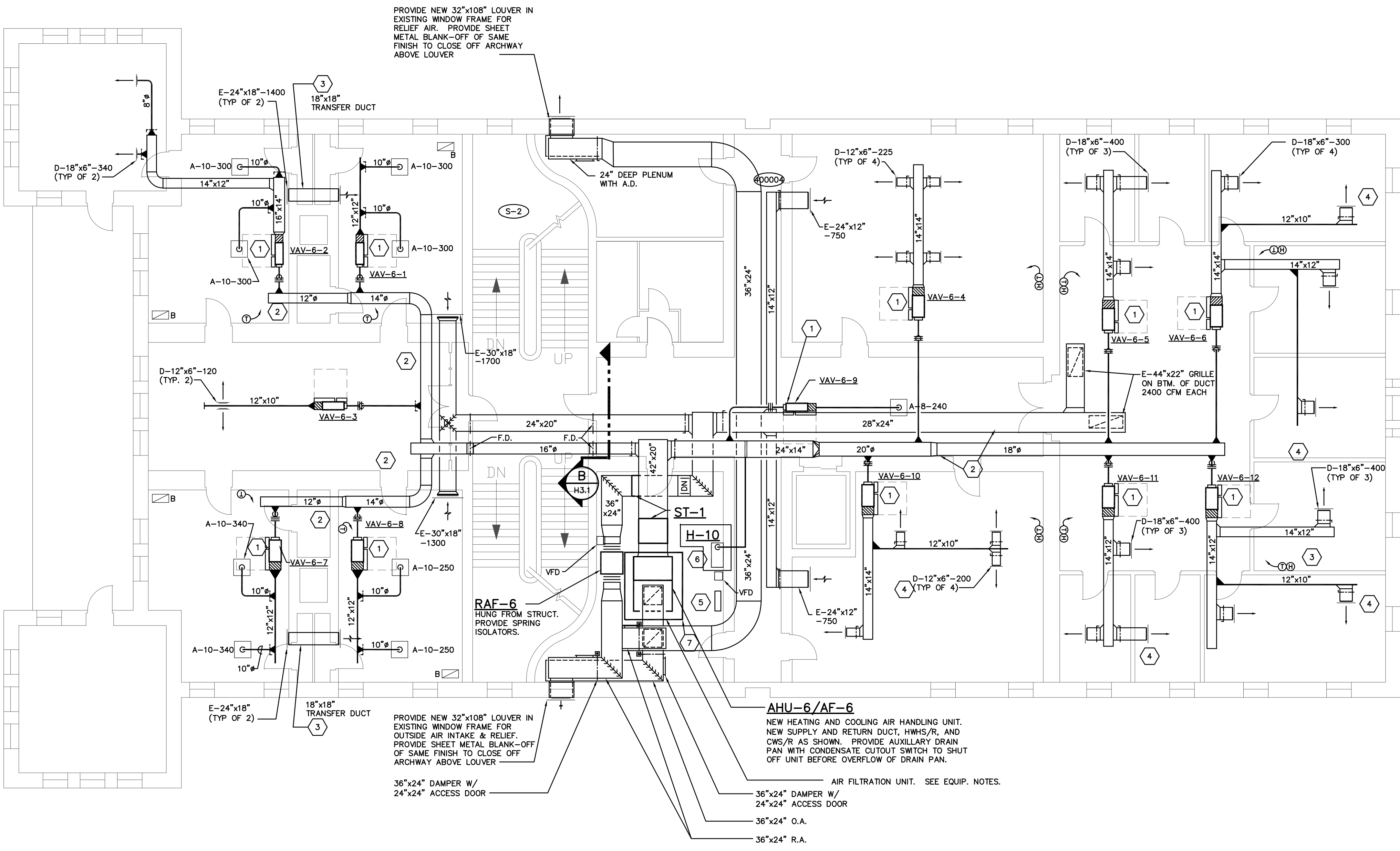
6130 Wilcox Road (614) 766 4896  
Dublin, Ohio 43016 praterengineering.com

DESIGNED BY B. OGLE	DRAWN BY BHO	CHECKED BY J. LOCKARD, P.E.	JOB NUM. 23069
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**CODED NOTES**

1. BOTTOM OF DUCT AT 10'-0". BOX TO BE ACCESSIBLE FOR MAINTENANCE.
2. INSTALL DUCT TIGHT TO STRUCTURE ABOVE.
3. TRANSFER DUCT HIGH WITH HIGH SIDEWALL GRILLES. BTM. APPROX. 9'-0" AFF.
4. DUCTS IN GALLERY SPACES WITHOUT SUSPENDED CEILINGS TO BE PAINTED BLACK TO BLEND WITH PAINTED SURFACES.
5. TEMPERATURE CONTROL PANEL.
6. UNDER ALTERNATE BID H-2 FURNISH AND INSTALL ELECTRIC HUMIDIFIER H-10, PIPING AND STEAM DISTRIBUTOR FOR GALLERY ZONES. TYPICAL OF 4 UNITS. MOUNT ELECTRIC HUMIDIFIER ON WALL. SUPPLY STEAM PIPING AND DUCT DISTRIBUTOR. SEE EQUIPMENT NOTES AND SCHEMATICS. RUN CONDENSATE TO FLOOR DRAIN.
7. FURNISH AND INSTALL A FULL SIZE DRAIN PAN BELOW UNIT AND PIPING. RUN OUTLET OF DRAIN PAN 1/4" TO FLOOR DRAIN. TYPICAL OF ALL NEW AHU's.

ALT.-H1



**FOURTH FLOOR HVAC PLAN**  
SCALE: 1/8"=1'-0"

**bdt** ARCHITECTS & DESIGNERS  
 26 E. Park Drive, Athens, Ohio 45701  
 OFFICE: 740.669.2400  
 ONLINE: www.bdtai.com  
 EMAIL: office@bdtai.com

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PROFESSIONAL SEAL

9/9/24

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**PROJECT TITLE**  
 OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701

PROJECT NUMBER: 23002  
 DATE: 10/31/23  
 DRAWN:

SHEET TITLE  
 FOURTH FLOOR  
 HVAC PLAN

SHEET  
**H4.1**

H4.1-23069.DWG

**PRATER**  
 Engineering Associates, Inc.

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 Dublin, Ohio 43016 praterengineering.com

DESIGNED BY B. OGLE	DRAWN BY BHO	CHECKED BY J. LOCKARD, P.E.	JOB NUM 23069
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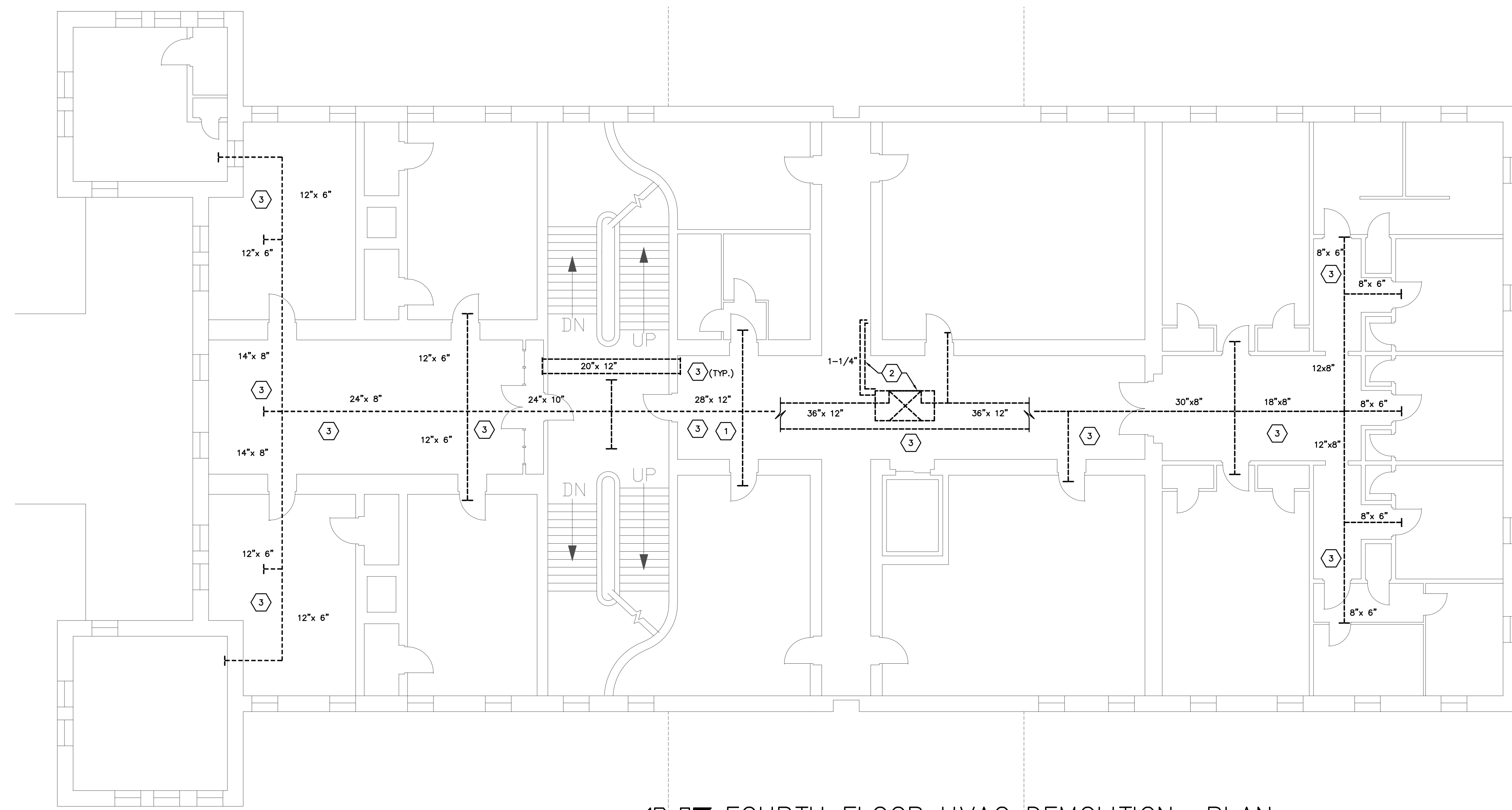
**CODED NOTES**

1. PIPING TO RUN BELOW DUCTWORK IN CORRIDORS. RUN AT SAME ELEVATION AS DUCTS WHERE CONNECTING TO VAV TERMINAL REHEAT COILS.
2. REMOVE EXISTING HEATING ONLY AIR HANDLING UNIT AH-6 SYSTEM. DISCONNECT AND REMOVE HEATING WATER SUPPLY AND RETURN LINES BACK TO RISER AND CAP.
3. REMOVE EXISTING UNINSULATED DUCTWORK AND HANGERS, FIRE DAMPERS, FIRE/SMOKE DAMPERS, GRILLES, ACCESSORIES.
4. DIFFERENTIAL PRESSURE TRANSMITTER.
5. THREE WAY CONTROL VALVE.

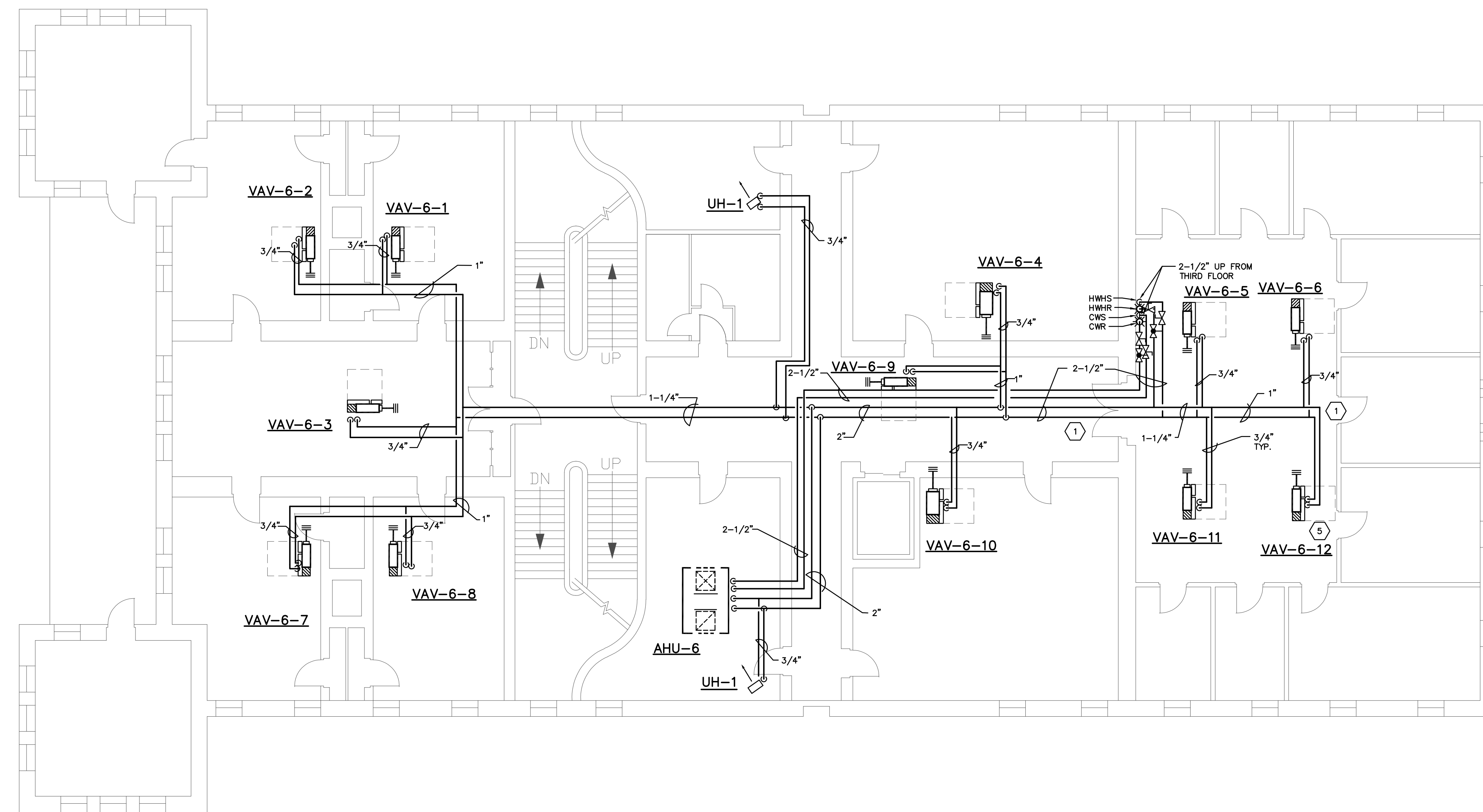


BDTAD, Inc.  
26 E. Park Drive, Athens, Ohio 45701  
OFFICE: 765.662.2402  
ONLINE: www.bdtad.com  
EMAIL: office@bdtad.com

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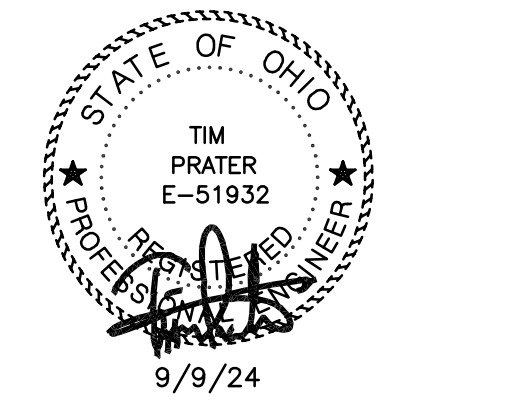


**FOURTH FLOOR HVAC DEMOLITION PLAN**  
SCALE: 1/8"=1'-0"



**FOURTH FLOOR PIPING HVAC PLAN**  
SCALE: 1/8"=1'-0"

PROFESSIONAL SEAL



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**OHIO MUSEUM COMPLEX  
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DRAWN

SHEET TITLE  
**FOURTH FLOOR HVAC DEMO  
AND HVAC NEW PIPING PLAN**

SHEET

**H4.2**

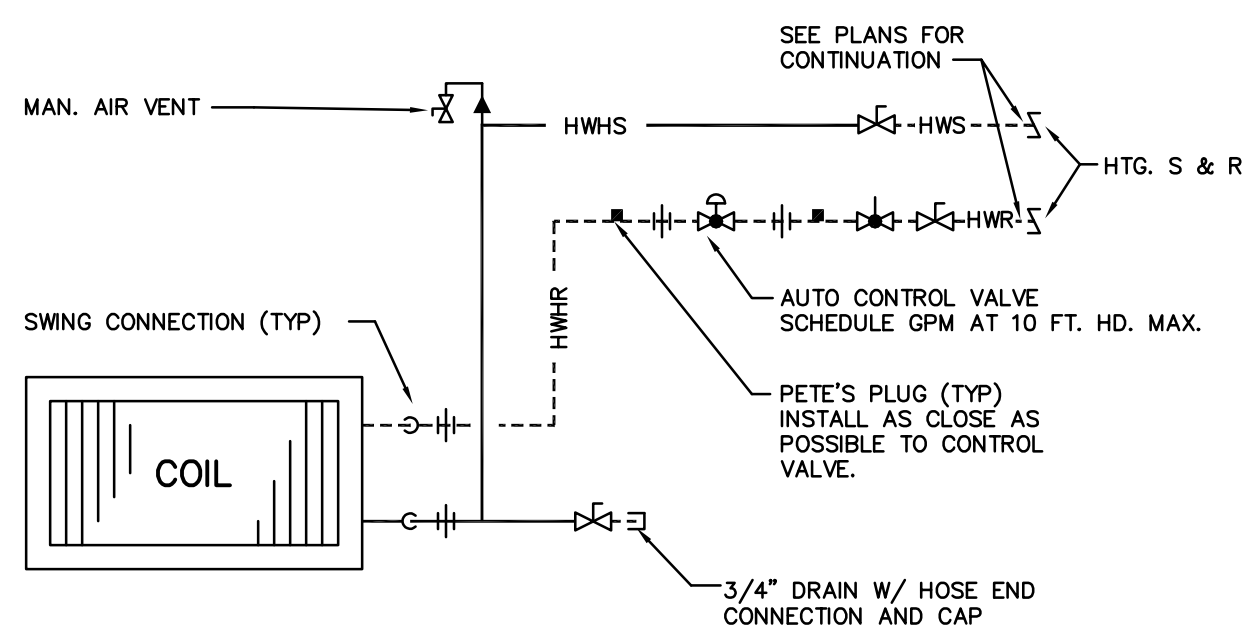
H4.2-23069.DWG

**PRATER**  
Engineering Associates, Inc.

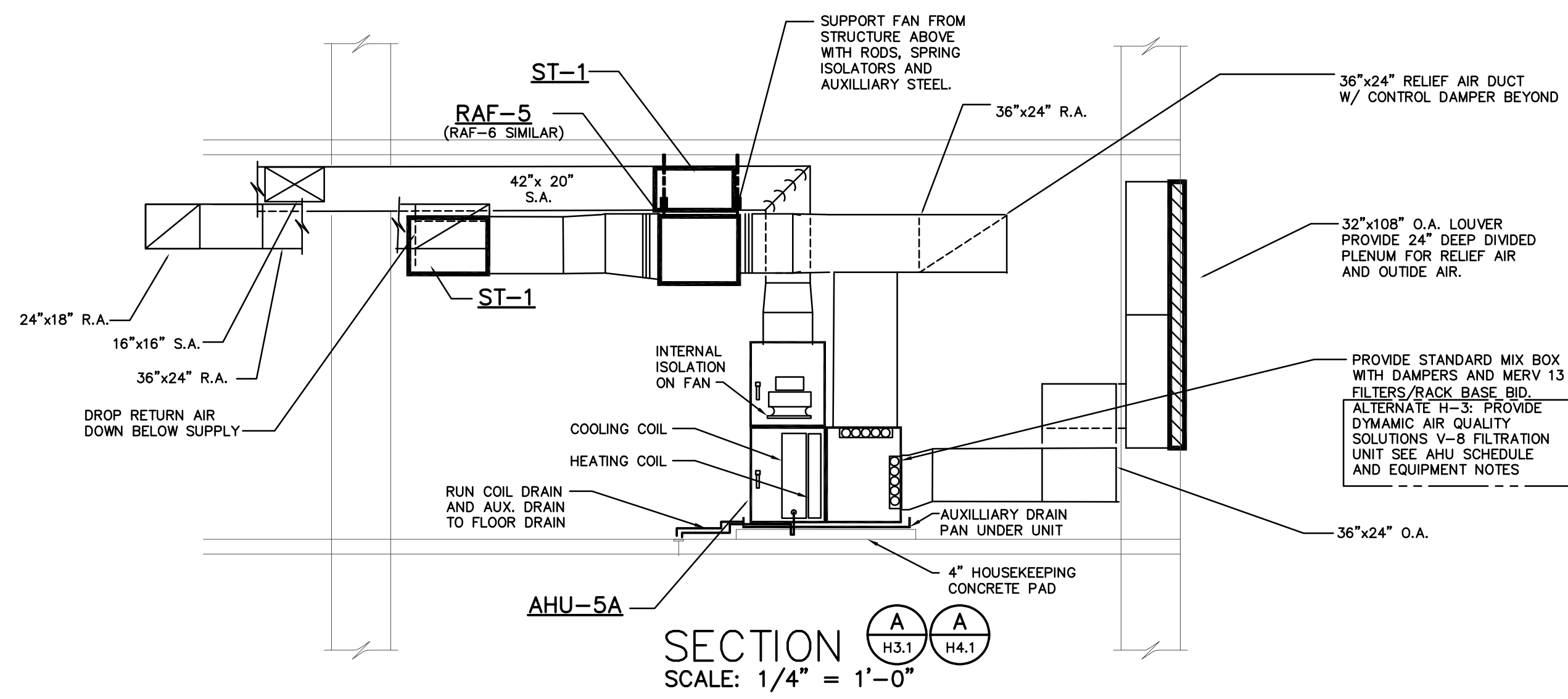
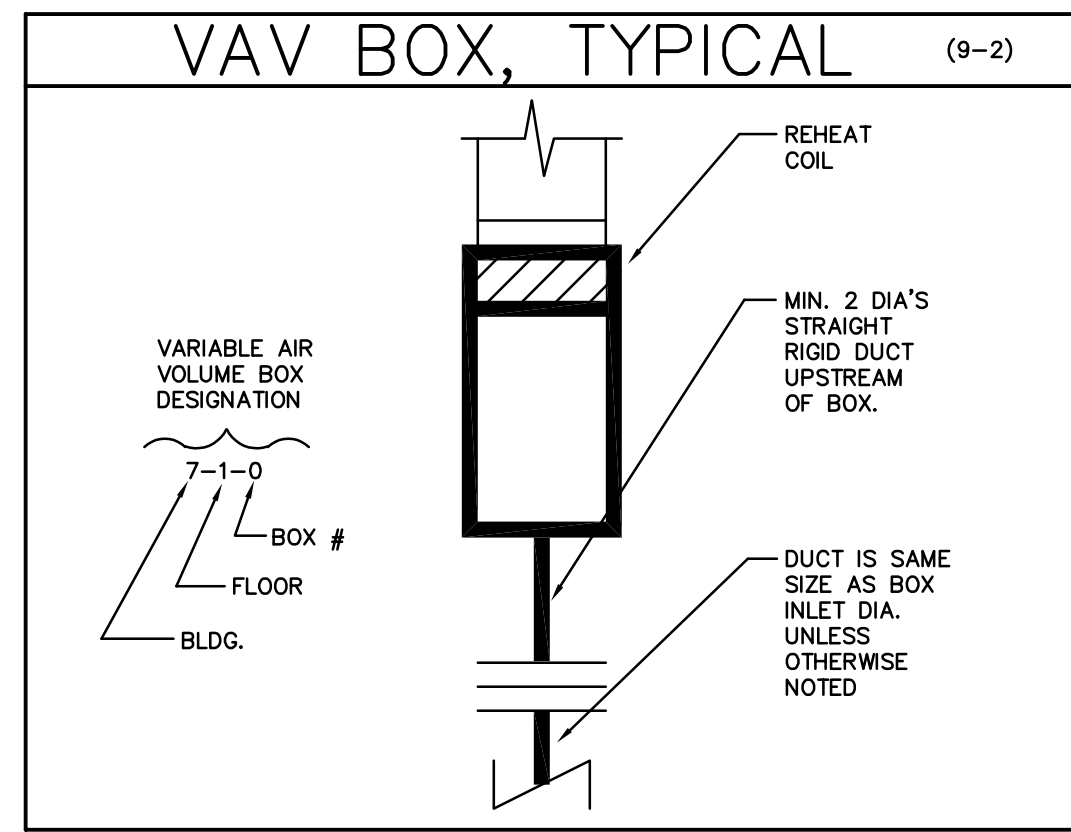
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Dublin, Ohio 43016 praterengineering.com

DESIGNED BY B. OGLE	DRAWN BY BHO	CHECKED BY J. LOCKARD, P.E.	JOB NUM. 23069
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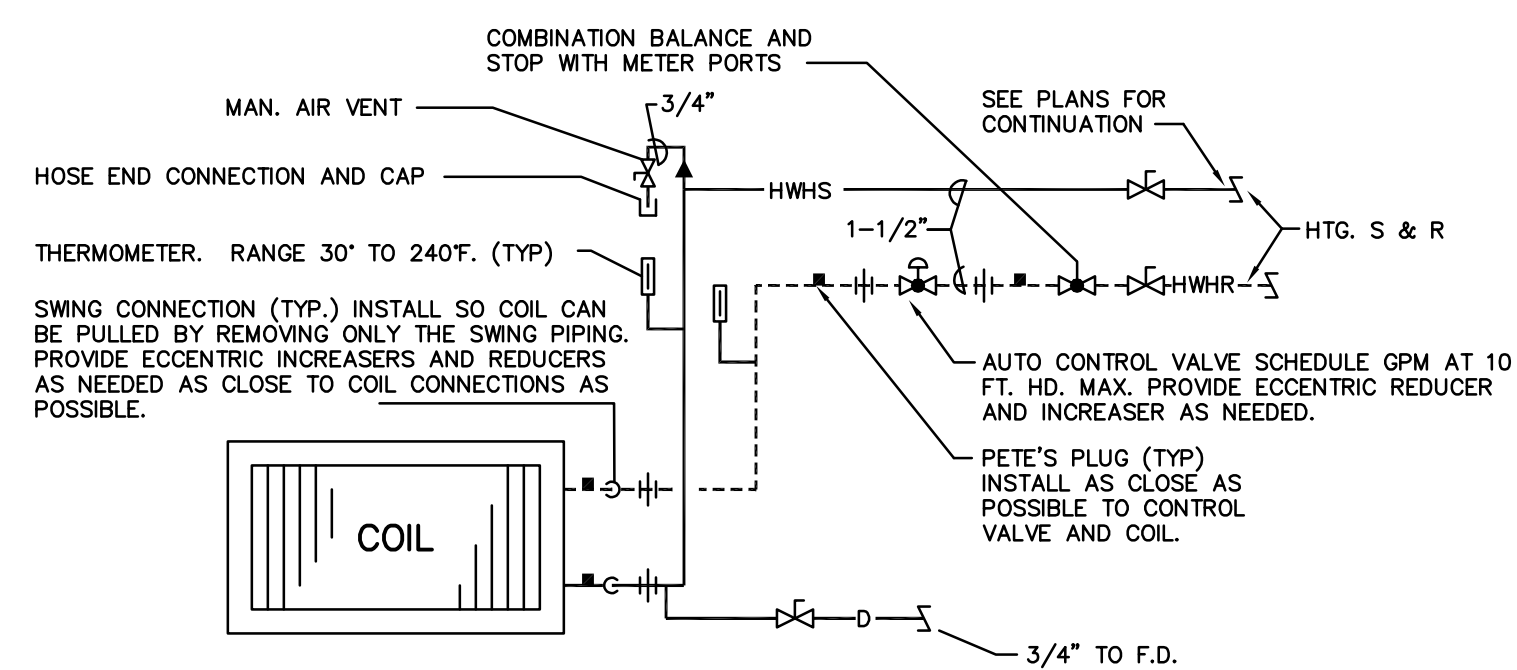
NOTE:  
1. PIPE SIZES AS LISTED IN VAV BOX SCHEDULE.



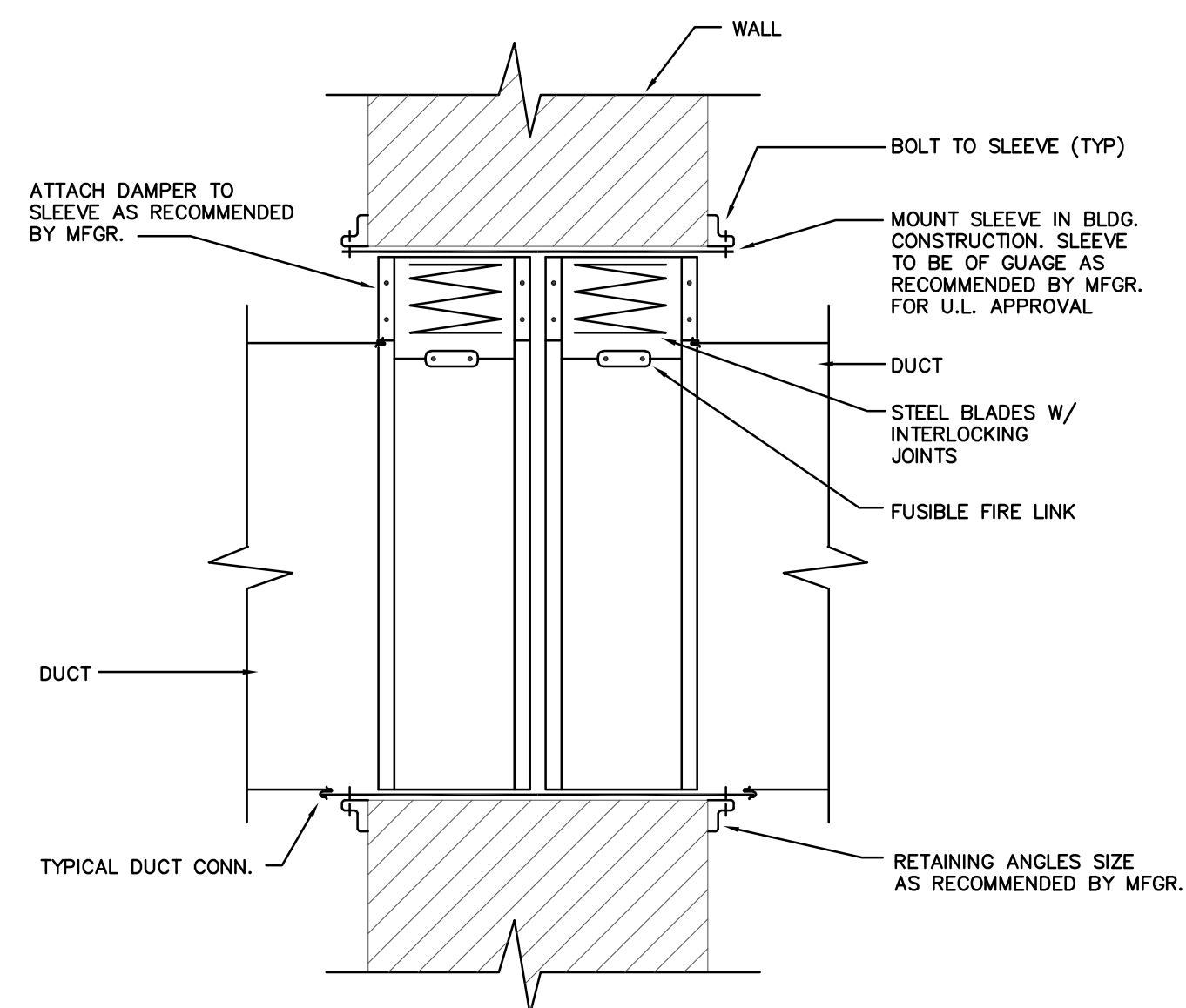
**BOX REHEAT COIL PIPING**  
2-WAY CONTROL VALVE



**SECTION**  
SCALE: 1/4" = 1'-0"

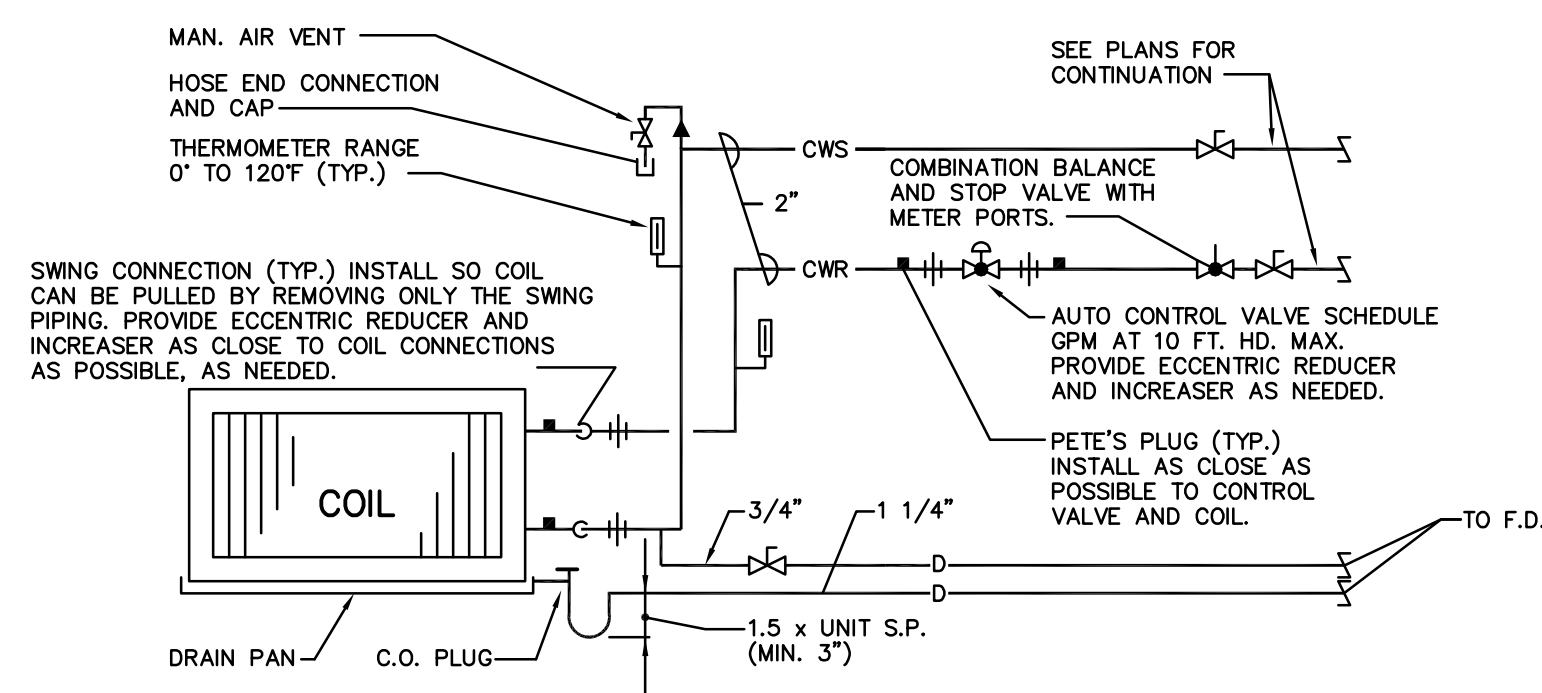


**HEATING COIL PIPING DETAIL**  
(2-WAY CONTROL VALVE)

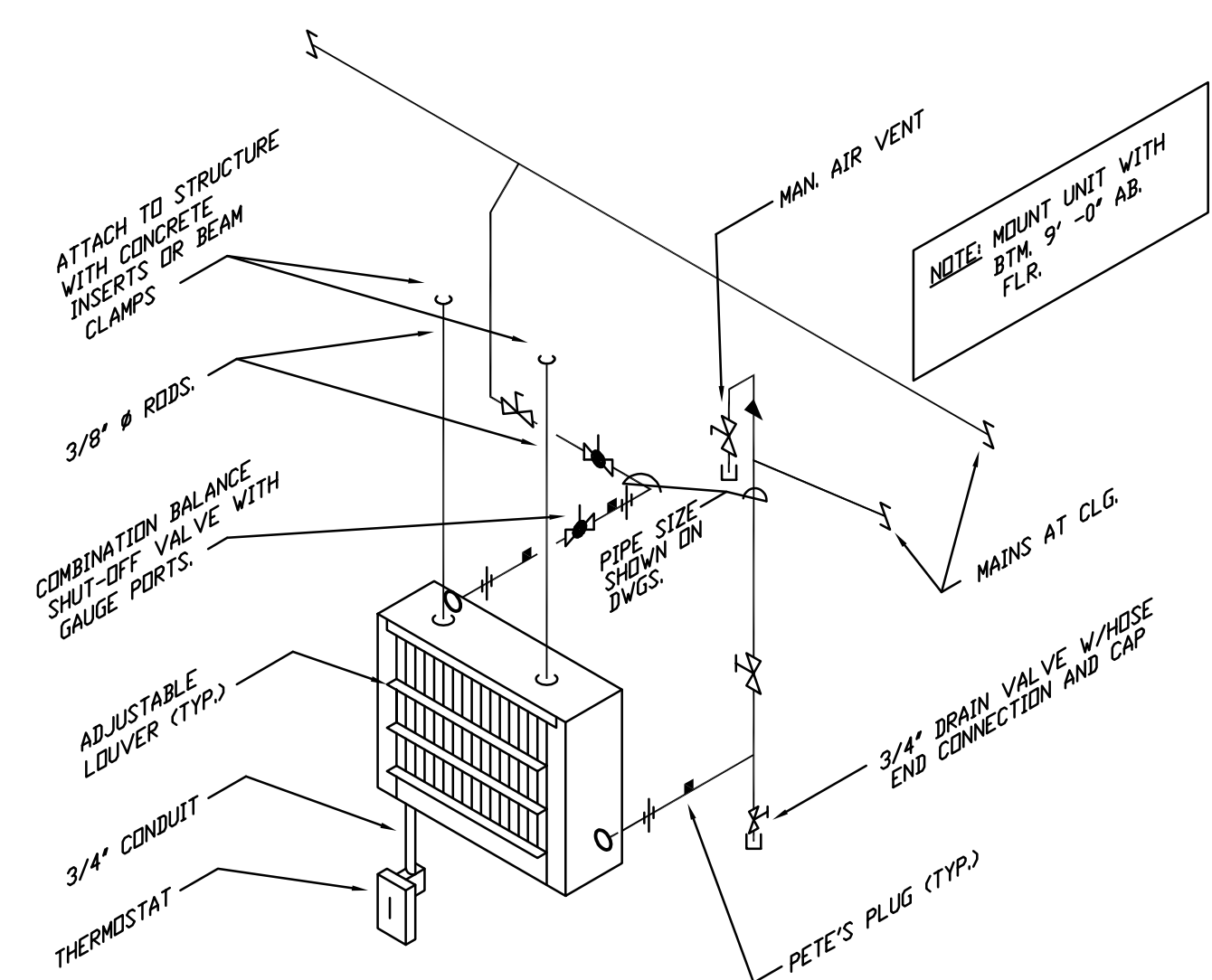


**NOTES:**  
DAMPER MUST BE SUPPORTED IN WALL BY SLEEVE & RETAINING ANGLES. DAMPER MUST REMAIN IN PLACE IF DUCT COLLAPSES.

**VERTICAL FIRE DAMPER TYPE "B" INSTALLATION (AT MONUMENTAL STAIR)**



**COOLING COIL PIPING**  
(2-WAY CONTROL VALVE)



**HORIZONTAL PROJECTION UNIT HEATER PIPING**  
(3 WAY VALVE)

PROFESSIONAL SEAL  
STATE OF OHIO  
TIM PRATER  
E-51932  
9/9/24

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9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701**

PROJECT NUMBER 23002  
DATE 10/31/23  
DRAWN

SHEET TITLE  
**FOURTH FLOOR  
HVAC PLAN**

SHEET  
**H5**

H5-23069.DWG  
**PRATER**  
Engineering Associates, Inc.  
6130 Wilcox Road (614) 766 4896  
Dublin, Ohio 43016 praterengineering.com  
DESIGNED BY B. OGLE DRAWN BY BHO CHECKED BY J. LOCKARD, P.E. JOB NUM. 23069

# HVAC NOTES

1. NOTE THAT EXISTING CONDITIONS SHOWN ON PLANS ARE FROM PREVIOUS ENGINEERING DOCUMENTATION AND FIELD OBSERVATION. ACTUAL CONDITIONS MAY VARY, AND MUST BE FIELD VERIFIED BY THIS CONTRACTOR (WHETHER SHOWN OR NOT). THIS CONTRACTOR SHALL MAKE MINOR ADJUSTMENTS AS NECESSITATED BY ACTUAL CONDITIONS, REQUIRED TO COMPLETE INSTALLATION OF NEW SYSTEM. IF EXISTING CONDITIONS PROHIBIT INSTALLATION OF NEW SYSTEM, NOTIFY THE CONSTRUCTION MANAGER/ARCHITECT/ENGINEER/OWNER REPRESENTATIVE FOR REDIRECTION AS REQUIRED.

2. REFER TO ARCHITECTURAL DOCUMENTATION FOR ADDITIONAL INFORMATION REGARDING DEMOLITION/REMODELING WORK, INCLUDING IDENTIFICATION OF AREAS AND ITEMS INVOLVED, AS WELL AS INFORMATION OF BOTH A GENERAL AND SPECIFIC NATURE.

3. UNLESS DIRECTED OTHERWISE, EXISTING COMPONENTS OF THE HVAC SYSTEM INCLUDING EQUIPMENT, DUCTWORK AND PIPING THAT ARE IN USE SHALL REMAIN. EXISTING HVAC SYSTEM COMPONENTS INCLUDING EQUIPMENT, DUCTWORK AND PIPING THAT OBSTRUCTS NEW WORK, OR WILL BE IN AN EXPOSED LOCATION AFTER THE PROJECT IS COMPLETE SHALL BE RELOCATED AS REQUIRED TO CLEAR NEW WORK OR BE IN A CONCEALED LOCATION.

4. UNLESS INDICATED OTHERWISE, WHEN EXISTING HVAC PIPING OR DUCTWORK ARE INDICATED TO BE REMOVED THE ITEM (WHETHER SHOWN ON PLANS OR NOT) AND ALL ASSOCIATED ACCESSORIES AND APPURTENANCES SHALL BE REMOVED. THIS INCLUDES ANY ITEMS ENCOUNTERED IN FIELD TO WHICH THESE DESCRIPTIVE CONDITIONS APPLY.

A. PIPING & DUCTWORK TO BE REMOVED BACK TO NEAREST ACTIVE BRANCH RE-MANNING IN SERVICE AFTER PROJECT COMPLETION, AND OUTSIDE OF ALL EXPOSED LOCATIONS, OR TO WITHIN NEW CONCEALING/FINISH STRUCTURE PROVIDED UNDER SEPARATE CONTRACT, AND CAPPED/PLUGGED (AS APPROPRIATE) AT THAT POINT.

B. WHEN AN ISOLATION VALVE OCCURS IN REMOVED SUPPLY PIPING AT THE ACTIVE BRANCH THE-IN POINT, THE VALVE SHALL REMAIN, AND THE CAP/PLUG SHALL BE ON THE SIDE OF THE VALVE ASSOCIATED WITH THE ITEM BEING REMOVED, IN THE VALVE OUTLET PIPING.

5. UNLESS DIRECTED OTHERWISE, WHERE CONCEALING/FINISH STRUCTURE IS PROVIDED UNDER SEPARATE CONTRACT, ALL WORK IN THE HVAC CONTRACT NOT SPECIFICALLY INTENDED OR IDENTIFIED FOR EXPOSED INSTALLATION SHALL BE INSTALLED WITHIN THE CONCEALING STRUCTURE.

6. CUTTING/REMOVAL AND REPAIR/REPLACEMENT OF EXISTING STRUCTURES AND/OR SURFACES REQUIRED BY WORK IN THE HVAC CONTRACT IS BY THE HVAC CONTRACTOR, UNLESS INDICATED OTHERWISE. REPAIR/REPLACEMENT TO BE TO ORIGINAL CONDITION, AND TO MATCH ADJACENT SURFACES IN TYPE, KIND AND FINISH. THIS INCLUDES CEILING, PARTITIONS, FLOORS, SOFFITS, ETC., BOTH WITHIN AND OUTSIDE THE REVISED/REMODELED AREA(S) THAT ARE AFFECTED BY WORK IN THE HVAC CONTRACT. THIS CONDITION DOES NOT APPLY TO EXISTING STRUCTURES AND/OR SURFACES ARE BEING REWIRED/REMOVED/RELOCATED UNDER SEPARATE CONTRACT.

7. REPLACE ALL INSULATION WHICH IS REMOVED FOR HAZARDOUS MATERIAL ABATEMENT WITH NEW INSULATION TO MEET THE REQUIREMENTS OF INSULATION SPECIFICATION. SEE HAZARDOUS MATERIAL ABATEMENT DOCUMENTATION FOR EXTENT OF REMOVAL/REPLACEMENT.

8. THE HVAC CONTRACTOR IS TO PROVIDE ALL ADDITIONAL STEEL, HANGERS, ROOFS, CLAMPS, ETC., AS REQUIRED FOR PROPER INSTALLATION, SUPPORT, AND COORDINATION WITH WORK PROVIDED UNDER SEPARATE CONTRACT. UNLESS INDICATED OTHERWISE IN PROJECT SPECIFICATIONS OR BY THE PIPE MATERIAL MANUFACTURER, SUPPORT PIPING AS FOLLOWS:

A. STEEL PIPING: 10 FT. CENTERS  
 B. COPPER PIPING: 8 FT. CENTERS

9. THE HVAC CONTRACTOR IS RESPONSIBLE FOR FIRESTOPPING AT ALL HVAC RELATED PENETRATIONS OF FIRE, SMOKE, AND OTHER RATED STRUCTURES, INCLUDING FLOORS, WALLS, PARTITIONS, ETC., FOR TO ARCHITECTURAL DOCUMENTATION FOR LOCATIONS OF ALL RATED STRUCTURES, AND SPECIFIC INFORMATION AND REQUIREMENTS PERTAINING TO SAME.

10. LAYOUT AND INSTALLATION OF HVAC CONTRACT DUCTWORK, PIPING, AND EQUIPMENT INDICATED ON PLAN IS SCHEMATIC IN NATURE. EXACT LOCATION, ROUTING AND INSTALLATION TO BE COORDINATED WITH BUILDING STRUCTURE AND ALL OTHER WORK PROVIDED UNDER SEPARATE CONTRACT(S).

11. RUN ALL WATER SUPPLY AND RETURN MAINS LEVEL UNLESS OTHERWISE NOTED.

12. RUNOUTS TO UNITS BELOW MAINS TO BE TAKEN FROM BTM. OF MAINS AT 45° PITCH UP TO UNITS. RUNOUTS TO UNITS AB. MAINS TO BE TAKEN FROM TOP OF MAINS AT 45° PITCH UP TO UNITS. PITCH -1" IN 10'-0".

13. RUN ALL DRAIN LINES INDIRECT TO NEAREST F.D. PITCH DRAIN LINES AT 1" DROP PER 10'-0" OF HORIZONTAL RUN.

14. INSTALL AIR VENTS AS INDICATED ON ALL UP-FEED HOT WATER HEATING UNITS.

15. INSTALL AIR VENTS AT HIGH POINTS OF SYSTEM, AS SHOWN ON DRAWINGS AND AS REQ'D. FOR PROPER AIR VENTING OF SYSTEM.

16. INSTALL WATER BALANCING DEVICES ON ALL WATER HEATING AND COOLING UNITS.

17. FOR FINED RADIATION OR RADIANT PANEL PIPING, ONLY CONTROL VALVES ARE SHOWN ON FLOOR PLANS FOR CLARITY. PROVIDE ADDITIONAL VALVING AS SHOWN ON THE PIPING DETAILS.

18. FINED RADIATION CABINETS TO RUN WALL TO WALL, WITH BOTTOM 4" ABOVE FLOOR, EXCEPT AS NOTED.

19. MOUNT BASE BOARD RADIATION UNITS WITH CABINET TIGHT TO FLOOR CABINET TO RUN WALL TO WALL EXCEPT AS NOTED.

20. MOUNT CABINET UNIT HEATERS WITH BOTTOM AT TOP OF FIRST BLOCK COURSE.

21. MOUNT CABINET UNIT HEATERS WITH BOTTOM 8" ABOVE FLOOR UNLESS OTHERWISE NOTED.

22. MBH VALUES SHOWN FOR UNIT VENTILATORS ARE EQUAL TO HEAT LOSS PLUS VENTILATION LOAD.

23. SIZE OF OUTSIDE AIR OPENINGS FOR UNIT VENTILATION TO BE DETERMINED BY UNITS ACTUALLY USED.

24. STEAM PIPING SYSTEM - PITCH STEAM AND CONDITION MAINS DOWN IN DIRECTION OF FLOW 1/4" IN 10'-0".

25. STEAM RUNOUTS TO UNITS TO BE TAKEN FROM TOP OF MAINS. PITCH 1" IN 10'-0". PITCH BACK TO MAINS.

26. REFER TO SPECIFICATION FOR START-UP OF RADIANT HEATING SYSTEM.

27. LEVEL AND TEST ALL SNOW MELTING RADIATION PIPING BEFORE CONCRETE IS POURED. SEE SPECIFICATIONS FOR TEST.

28. STEAM CONDENSATE PIPING SHALL BE INSTALLED BELOW STEAM MAINS TO INSURE THAT CONDENSATE DOES NOT HAVE TO BE LIFTED TO ENTER CONDENSATE RETURN MAINS.

29. COORDINATE EXACT LOCATION OF DUCT RISERS IN PIPE SPACES WITH PLUMBING STACKS BY PLUMBING CONTRACTOR.

30. CAULK SPACE BETWEEN SLEEVES, DUCTS AND PIPES WHERE DUCTS AND PIPES PASS THROUGH WALL OF RETURN AIR SHAFTS. CAULKING TO BE AIRTIGHT.

31. ALL DUCTS AND PIPES ABOVE CEILING UNLESS OTHERWISE NOTED.

32. OPENINGS THROUGH OUTSIDE WALL FOR LOUVERS BY GENERAL CONTRACTOR ALL LINTELS AND WEATHERTIGHT SETTING OF LOUVERS BY GENERAL CONTRACTOR.

33. OPENINGS THROUGH OUTSIDE WALL AND LINTELS FOR LOUVERS BY GENERAL CONTRACTOR WEATHERTIGHT SETTING OF LOUVERS BY HEATING CONTRACTOR.

34. OPENINGS THROUGH ROOF BY GENERAL CONTRACTOR. FURNISH AND SETTING OF PREFABRICATED CURBS AND FANS BY HEATING CONTRACTOR.

35. SIZE OF OUTSIDE AIR OPENINGS, FOR HEATING & COOLING UNITS TO BE DETERMINED BY UNITS ACTUALLY USED.

36. OFFSET DUCTS INTO JOIST SPACE FOR CLEARANCE WHERE SPACE ABOVE CEILING IS NOT SUFFICIENT FOR DUCTS TO CROSS OTHER DUCTS OR WORK OF OTHER CONTRACTORS.

37. NOTIFY THE GENERAL CONTRACTOR OF SIZE AND LOCATION OF ALL RECESSES AND OPENINGS REQUIRED FOR HEATING WORK.

38. FLASHING AND COUNTERFLASHING AT GOOSENECK BY HEATING CONTRACTOR.

39. INSTALL BALANCING DAMPERS AS SHOWN AND AS REQUIRED FOR PROPER BALANCING AIR HANDLING SYSTEMS.

40. CROSS-HATCHED DUCT TO BE LINED INSIDE WITH 1" THICK COATED GLASS FIBER INSULATION. DUCT DIMENSION GIVEN IS ACTUAL INSIDE OPENING AFTER INSULATION IS APPLIED AND SHALL NOT BE SMALLER.

41. PROVIDE AIRTIGHT ACCESS DOORS IN DUCTS ADJACENT TO ALL AUTOMATIC DAMPERS AND TEMPERATURE CONTROL DEVICES.

42. REFER TO ARCHITECTURAL REFLECTED CEILING PLAN FOR EXACT LOCATION OF DIFFUSERS, GRILLES, ETC.

43. "AUTO-CONTROL" DAMPERS ARE TO BE PROVIDED BY TEMPERATURE CONTROL CONTRACTOR. ALL OTHER DAMPERS INCLUDING "MOTORIZED DAMPERS" ARE TO BE PROVIDED BY HEATING CONTRACTOR.

44. CROSS-HATCHED HIGH PRESSURE DUCT IS TO BE DOUBLE WALL TYPE "K-27" WITH 1" INSULATION BETWEEN WALLS. DUCT OPENING OF INTERIOR LNER AND SHALL NOT BE SMALLER.

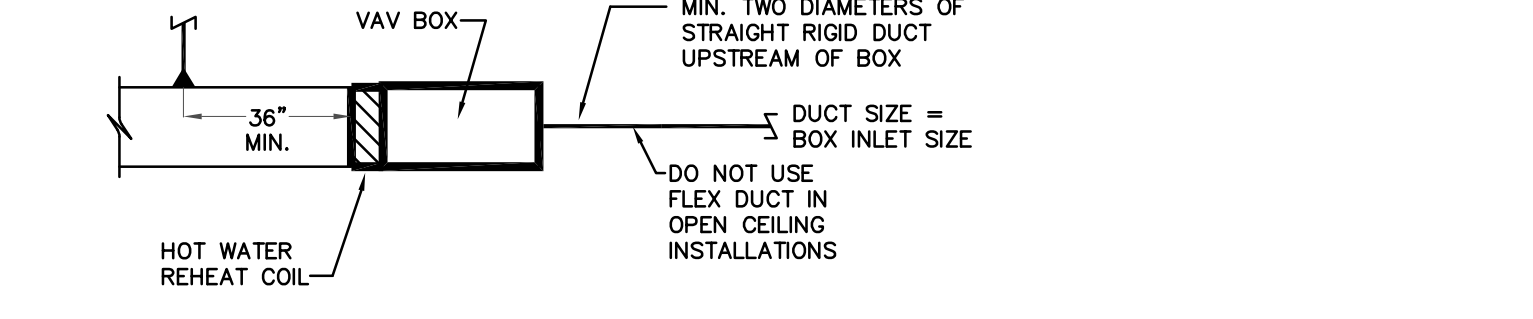
# AIR HANDLING UNIT SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON AAHN V-3 SERIES UNLESS OTHERWISE NOTED.  
 MZ - MULTI-ZONE; H & A/C - HEATING AND AIR CONDITIONING; H & V - HEATING & VENTILATING; F.C. - FORWARD CURVED; A.F. - AIR FOL; A.T.L. - ACROSS THE LINE; VAV - VARIABLE AIR VOLUME; VFD - VARIABLE FREQUENCY DRIVE

UNIT NUMBER	LOCATION	MFR. & MODEL NUMBER	TYPE	FAN DATA					MOTOR DATA				COOLING COIL DATA					HEATING COIL DATA					GEN. INFORMATION					REMARKS														
				CFM	TOTAL S.P. W.G.	EXT. S.P. W.G.	RPM	WHEEL TYPE & SIZE	TIP SPEED F.P.M.	O.V. F.P.M.	MOTOR H.P.	B.H.P. REQ'D.	VOLTS PHASE	TYPE MOTOR STARTING	CFM	ROWS & TYPE FIN	GPM	WTR. P.D. FT. HD.	AIR P.D. " W.G.	COL. F.A. SQ. FT.	ENT. AIR TEMP. (F)	LVG. AIR TEMP. (F)	D.B. (F)	W.B. (F)	D.B. (F)	W.B. (F)	CFM	ROWS & TYPE FIN	GPM	WTR. P.D. FT. HD.	AIR P.D. " W.G.	COL. F.A. SQ. FT.	ENT. AIR TEMP. (F)	LVG. AIR TEMP. (F)	ARRANG.	FILTER AREA SQ. FT.	MIN. DCV	O.A. DCV MAX.				
AHU-5	THIRD FLOOR	V3-ERB-8 -O-29HC- 12K-F34-C	VAV	8800	3.5	1.75	2234	2 AF x 18.5	9430	PLENUM O.V. 55FPM	2 x 5 HP	4.07 BHP UNIT F.L.A. = 21 (FAN = 10.4)	208	3	VFD	8800	6 ROW 12 FPI	45.0	13.9	0.96	17.6	80.5	65.9	52.6	52.5	8800	2 ROW 8 FPI	31.6	1.2	0.16	17.6	49.5	95.8	VERTICAL DRAW TRAP	DYNAMIC AIR MERV-14 (24 V AC)	500	2400	1	2	3	4	5
AHU-6	FOURTH FLOOR	V3-ERB-8 -O-29HC- 12K-F34-C	VAV	8800	3.5	1.75	2234	2 AF x 18.5	9430	PLENUM O.V. 55FPM	2 x 5 HP	4.07 BHP UNIT F.L.A. = 21 (FAN = 10.4)	208	3	VFD	8800	6 ROW 12 FPI	45.0	13.9	0.96	17.6	80.5	65.9	52.6	52.5	8800	2 ROW 8 FPI	31.6	1.25	0.16	17.6	49.5	95.8	VERTICAL DRAW TRAP	DYNAMIC AIR MERV-14 (24 V AC)	500	2400	1	2	3	4	5

- 1 COOLING COIL TOTAL 320 MBH, SENS. 240 MBH
- 2 UNIT MCA =12; MOCP = 15A  
VFD FURNISHED BY MECH. CONTR.
- 3 UNIT TO BE FURNISHED WITH FILTER BOX FOR DYNAMIC V-B AIR FILTRATION SYSTEM. COORDINATE DIMENSIONS AND ACCESS DOOR LOCATIONS WITH AIR CLEANER MANUFACTURER.
- 4 AIR FILTRATION BY HVAC CONTRACTOR FIELD INSTALLED IN AIR HANDLING UNIT FILTER BOX. SEE EQUIPMENT NOTES THIS SHEET FOR AIR FILTRATION SYSTEM MODEL.
- 5 BASE BID FILTRATION IS STANDARD MIXING BOX WITH INTEGRAL MOTORIZED DAMPERS FURNISH WITH MERV 13 CARTRIDGE FILTERS

## TERMINAL BOX SCHEDULE



- NOTES
1. VAV & FPVAV TERMINAL UNITS BASED ON JCI TSS BOXES.
  2. NC LEVEL SHALL NOT EXCEED 32.
  3. MODEL TSS = SINGLE DUCT VAV BOX W/ HOT WATER REHEAT COIL.
  4. ALL MODEL TSS BOXES ARE TO BE PROVIDED WITH HOT WATER REHEAT COILS WITH CAPACITY AS NOTED.
  5. HVAC CONTR. TO DETERMINE R.H. OR L.H. CONTROLS SIDE.
  6. ATTENUATORS NOT SHOWN ON PLANS. PROVIDE ATTENUATORS FOR ALL BOXES UNLESS NOTED OTHERWISE.
  7. ALL BOXES SHALL BE FURNISHED WITH ELECTRICAL TRANSFORMER AND CONNECTION FOR CONTROLS. COORDINATE WITH E.C.
  8. FURNISH WITH FLOWSTAR AVERAGING FLOW SENSOR AND CONTROLS ENCLOSURE. DAMPER CONTROL AND DISCHARGE AIR SENSOR SHALL BE PROVIDED BY OTHERS (DELTA OR AUTOMATED LOGIC CORP). COORDINATE WITH CONTROLS CONTRACTOR FOR MIN. AND MAX. TRANSDUCER DIFFERENTIAL PRESSURE. COORDINATE WITH CONTROLS PROVIDER ON SPACE REQUIRED FOR CONSISTENT CONTROLLER AND ACTUATOR.

MARK	MODEL	UNIT SIZE	INLET SIZE	MAX. VALVE SIZE	MIN. VALVE COOLING CFM	VALVE HEATING CFM	LAT (EAT 55 F)	MBH	GPM	LWT (ENT 180 F)	ROWS	APD	PIPE SIZE	REMARKS
VAV-5-1	TSS -WC	08	8"	600	180	300		15.8	1.1				3/4"	1 2
VAV-5-2	TSS -WC	12	12"	1200	360	600		54.4	3.6				1"	1 2 4
VAV-5-3	TSS -WC	06	6"	240	75	120		6.8	0.5				3/4"	1 2 4
VAV-5-4	TSS -WC	10	10"	800	240	400		30.9	2.1				3/4"	1 2 4
VAV-5-5	TSS -WC	10	10"	800	240	400		11.7	0.8				3/4"	1 2 4
VAV-5-6	TSS -WC	12	12"	1200	360	600		17.6	1.2				3/4"	1 2 4
VAV-5-7	TSS -WC	08	8"	800	180	300		21.7	1.4				3/4"	1 2 4
VAV-5-8	TSS -WC	10	10"	800	240	400		30.8	2.1				3/4"	1 2 4
VAV-5-9	TSS -WC	06	6"	240	75	120		6.8	0.5				3/4"	1 2 4
VAV-5-10	TSS -WC	10	10"	800	240	400		32.5	2.2				3/4"	1 2 4
VAV-5-11	TSS -WC	10	10"	800	240	400		11.7	0.8				3/4"	1 2 4
VAV-5-12	TSS -WC	12	12"	1600	480	800		23.4	1.6				3/4"	1 3 4
VAV-6-1	TSS -WC	08	8"	600	180	300		15.9	1.1				3/4"	1 2 4
VAV-6-2	TSS -WC	08	12"	1280	385	640		43.9	2.9				3/4"	1 2 4
VAV-6-3	TSS -WC	06	6"	240	75	120		10.8	0.7				3/4"	1 2 4
VAV-6-4	TSS -WC	10	10"	900	270	450		32.6	2.2				3/4"	1 2 4
VAV-6-5	TSS -WC	10	12"	1200	360	600		29.5	2.0				3/4"	1 2 4
VAV-6-6	TSS -WC	10	12"	1200	360	600		29.5	2.0				3/4"	1 2 4
VAV-6-7	TSS -WC	10	10"	880	205	340		28.7	1.8				3/4"	1 2 4
VAV-6-8	TSS -WC	08	8"	500	150	250		17.8	1.2				3/4"	1 2 4
VAV-6-9	TSS -WC	06	6"	240	75	120		6.6	0.4				3/4"	1 2 4
VAV-6-10	TSS -WC	10	10"	800	240	400		35.3	2.4				3/4"	1 2 4
VAV-6-11	TSS -WC	10	12"	1200	360	600		32.8	2.2				3/4"	1 2 4
VAV-6-12	TSS -WC	10	12"	1200	360	600		32.8	2.2				3/4"	1 3 4

- 1 NEW SINGLE DUCT BOX W/HOT WATER REHEAT.
- 2 PROVIDE WITH 2-WAY CONTROL VALVE
- 3 PROVIDE WITH 3-WAY CONTROL VALVE
- 4 MBH BASED ON 180 ENT.

## AIR TERMINAL SCHEDULE

TYPE	DESCRIPTION
B	RETURN AIR GRILLE, LAY-IN, PRICE MODEL 530, 45° FIXED BLADES, STEEL, 24"x12" UNLESS OTHERWISE NOTED. PROVIDE WITH PLASTER FRAME WHERE NECESSARY TO INSTALL LAY-IN DEVICE IN HARD CEILING.
C	LINEAR SUPPLY AIR DIFFUSER, SURFACE MOUNTED, PRICE MODEL SD575, 3/4" SLOTS, 4'-0" LONG UNLESS OTHERWISE NOTED. FURNISH W/ MODEL S08H INSULATED PLENUM W/ INLET CONNECTION SIZE EQUAL TO BRANCH DUCT SIZE.
D	SUPPLY AIR REGISTER, SURFACE MOUNTED, PRICE MODEL S200; 8"x8" UNLESS OTHERWISE NOTED. FURNISH WITH OPPOSED BLADE DAMPER. FURNISH WITH FRONT BLADES PARALLEL TO "SHORT" DIMENSION.
E	RETURN/EXHAUST AIR REGISTER, SURFACE MOUNTED, PRICE MODEL 530; 24"x12" UNLESS OTHERWISE NOTED. FURNISH WITH BLADES PARALLEL TO "LONG" DIMENSION. PROVIDE ALUMINUM MODEL FOR RESTROOM APPLICATIONS.
F	RETURN/EXHAUST AIR GRILLE, SURFACE MOUNTED, PRICE MODEL STG; 22"x18" UNLESS OTHERWISE NOTED. FURNISH WITH BLADES PARALLEL TO "LONG" DIMENSION.

## EQUIPMENT NOTES

**UH-1**  
 HORIZONTAL HOT WATER UNIT HEATER - TRANE MODEL 'S' S-084 - 39.3 MBH TOTAL HEATING CAPACITY, 3.6 GPM, 160°F EWT, 130° LWT, 0.45 FT. HD. W.P.D., 900 CFM AIRFLOW, 1000 RPM, 2.8MVA/5.5MHP 1/2HP MOTOR, 115/60/1 POWER, FURNISH WITH INTEGRAL DISCONNECT SWITCH, TOTALLY ENCLOSED MOTOR, COPPER TUBES, WALL MOUNTING BRACKET, CAPACITIES BASED ON 60°F ENTERING AIR TEMPERATURE, CONTROLS BY TCC, DOO SENSOR IN ROOM.

**L-1 LOUVER**  
 EXTERIOR WALL LOUVERS, MIN. 53.5% FREE AREA DRAINABLE LOUVER, INTAKE LOUVERS SHALL BE "RATED FOR 1000FPM FREE AIR VELOCITY OR GREATER BEFORE WATER PENETRATION OCCURS, AEROLITE MODEL K-4776 6" DEEP LOUVER WITH FACTORY APPLIED GREY KYNAR FINISH.

**AF-5.6 AIR FILTRATION UNITS**  
 DYNAMIC AIR QUALITY SOLUTIONS AIR FILTRATION SYSTEM MODEL 1V-8-43-06-29.5, MIN MERV 14 RATING; 47"W X 33"H X 29.5" DEEP V-BANK SYSTEM MOUNTED IN AHU FILTER BOX PROVIDED BY UNIT MANUFACTURER. COORDINATE DIMENSIONS AND ACCESS DOOR LOCATIONS). CAPACITY PER AHU SUPPLY FAN CFM, INITIAL AIR PRESSURE DROP 0.25 INCH. MAX FACE VELOCITY OF 400 FPM.

**H-9 AND H-10 HUMIDIFIER**  
 CONDAR ELECTRIC HUMIDIFIER MODEL EL 30. EACH UNIT TO DELIVER STEAM TO PROCESS 3000 CFM FROM 85°F AND 39.2 GR/LB ABSOLUTE HUMIDITY TO 72° AND 50.2 GR/LB ABS. HUMIDITY (43% RH AIR DELIVERED TO SPACE). 208V/3PH/60HZ, 11.25 KW, FURNISH WITH DUCT DISTRIBUTION ACCESSORIES TO MATCH DUCT SIZE AND ABSORPTION DISTANCE REQUIREMENTS FOR DUC LOCATION. REFER TO SPECIFICATIONS SECTION 2318 29.13.

**ST-1**  
 INDUSTRIAL ACOUSTICS COMPANY MODEL LFM SOUND TRAP. MATCH DUCT SIZE FACE AREA, 3 FT. LENGTH. MAX. STATIC PRESS. DROP 0.23" AT 1100 FPM.

## WATER RE-BALANCE

TAB CONTRACTOR WITH COOPERATION OF TCC TO CHECK EXISTING FLOWS AND BALANCE ADDITIONAL NEW COILS WHILE MAINTAINING EXISTING MAX DESIGN FLOWS SHOWN IN TABLE

EXIST. HEATING WATER PUMPS P-1 AND P-2	250 GPM @ 70 FT.	243.7	EXIST. BUILDING GHW PUMPS 12-1 AND 12-2	360 GPM @ 85 FT.	316.3
EXIST. AHU-1 (BASEMENT)		15.0	EXIST. AHU-1 (BASEMENT)		75.0
EXIST. AHU-2 (BASEMENT)		11.0	EXIST. AHU-2 (BASEMENT)		55.0
EXIST. AHU-3 (BASEMENT)		13.0	EXIST. AHU-3 (BASEMENT)		25.2
EXIST. AHU-4 (SECOND FLOOR MECH. RM.)		14.0	EXIST. AHU-4 (SECOND FLOOR MECH. RM.)		37.3
EXIST. AHU-4A (SECOND FLOOR AB. CORR.)		7.5	EXIST. AHU-4A (SECOND FLOOR AB. CORR.)		---
EXIST. FCU-1 RM 211		15.0	EXIST. AHU-7 (ARCHIVES MEZZANINE)		6.9
EXIST. AHU-7 (ARCHIVES MEZZANINE)		50.0	EXIST. HOT WATER TERMINAL UNITS		26.9
EXIST. HOT WATER TERMINAL UNITS		31.6	NEW AHU-5		45.0
NEW AHU-6		31.6	NEW AHU-6		45.0
NEW HOT WATER TERMINAL UNITS		55.0			

## FAN SCHEDULE

MANUFACTURER'S MODEL NUMBER BASED ON GREENHECK UNLESS OTHERWISE NOTED.  
 KEY: CENT-CENTRIFUGAL; PROP-PROPELLER; F.C-FORWARD CURVED; B1-BACKWARD INCLINE; M.F. - MIXED FLOW; A.F.-AIR FOL; A.T.L.-ACROSS THE LINE; VFD-VARIABLE FREQUENCY DRIVE

FAN NO.	LOCATION	FUNCTION	MFR. MODEL NUMBER	FAN TYPE	WHEEL TYPE & SIZE	CFM	TOTAL S.P. W.G.	R.P.M.	TIP SPEED F.P.M.	OUTLET VELOCITY F.P.M.	MAX. SOUND RATING	MOTOR H.P.	BHP REQ'D	VOLT	PHASE	TYPE MOTOR STARTING	DAMPER DRIVE		REMARKS
																	GRAVITY	INTERLOCK	
RF-5	MECH RM.	MECH RM VENTILATION	GREENHECK SQ-22-M2	INLINE RETURN	M.F. 27"	8300	0.75"	1160	-	896	19.0 INLET SONES	3.0	2.24	208	3	A.T.L.			1 6
RF-6	MECH RM.	MECH RM VENTILATION	GREENHECK SQ-22-M2	INLINE RETURN	M.F. 27"	8300	0.75"	1160	-	896	19.0 INLET SONES	3.0	2.24	208	3	A.T.L.			1 6

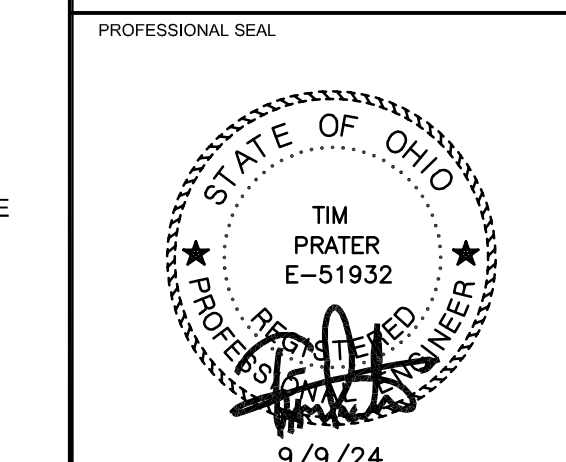
1 VFD MOTOR CONTROL OF DIRECT DRIVE MOTOR  
 2 PROVIDE WITH MOTOR OPERATED 120V DAMPER INTERLOCKED WITH UNIT OPERATION  
 3 FAN TO BE FURNISHED W/ FACTORY MOUNTED VARIABLE SPEED SWITCH FOR BALANCING.  
 4 INTERLOCK MOTOR OPERATED 120V DAMPER ON INTAKE LOUVER WITH LT-1 OPERATION

H6-23069.DWG

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DESIGNED BY: B. OGLE  
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 CHECKED BY: J. LOCKARD, P.E.  
 JOB NUM: 23069



ISSUE DATES

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

SECTION 25 00 01 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

- 1.01 RELATED DOCUMENTS
  - A. DRAWINGS AND GENERAL PROVISIONS OF THE CONTRACT, INCLUDING GENERAL AND SUPPLEMENTARY CONDITIONS AND DIVISION 01 SPECIFICATION SECTIONS, APPLY TO THIS SECTION.
  - B. REFER TO ELECTRICAL DRAWINGS FOR SPECIFIC REQUIREMENTS AS THEY RELATE TO CONTROL DIAGRAMS.
- 1.02 SUMMARY
  - A. THIS SECTION INCLUDES CONTROL SEQUENCES FOR HVAC SYSTEMS, SUBSYSTEMS, AND EQUIPMENT.
  - B. RELATED SECTIONS INCLUDE THE FOLLOWING:
    - 1. SECTION 25 00 00 TEMPERATURE CONTROLS FOR CONTROL EQUIPMENT AND DEVICES, SUBMITTALS, QUALITY ASSURANCE, COORDINATION AND TRAINING REQUIREMENTS.
- 1.03 SCOPE
  - A. THE CONTROL SEQUENCES AS DESCRIBED BELOW SHALL BE INCORPORATED IN THE DDC (DIRECT DIGITAL CONTROL) SYSTEM OPERATION.
  - B. THE CONTROLS CONTRACTOR SHALL CONFIRM THE SYSTEM IS FULLY FUNCTIONING. REFER TO 25 00 00 TEMPERATURE CONTROLS FOR MORE DETAILED REQUIREMENTS.

PART 2 - PRODUCTS

NOT APPLICABLE.

PART 3 EXECUTION

- 3.01 DDC TEMPERATURE CONTROL SEQUENCES
  - A. HEATING WATER AND CHILLED WATER CONTROL (EXISTING)
    - 1. HOT WATER HEATING AND CHILLED WATER TEMPERATURES ARE MAINTAINED BY EXISTING DELTA CONTROLS LOCATED IN BASEMENT. A RESET SCHEDULE FOR HEATING WATER IS EXISTING AS FOLLOWS (TOC TO VERIFY AND ADJUST AS NECESSARY):
 

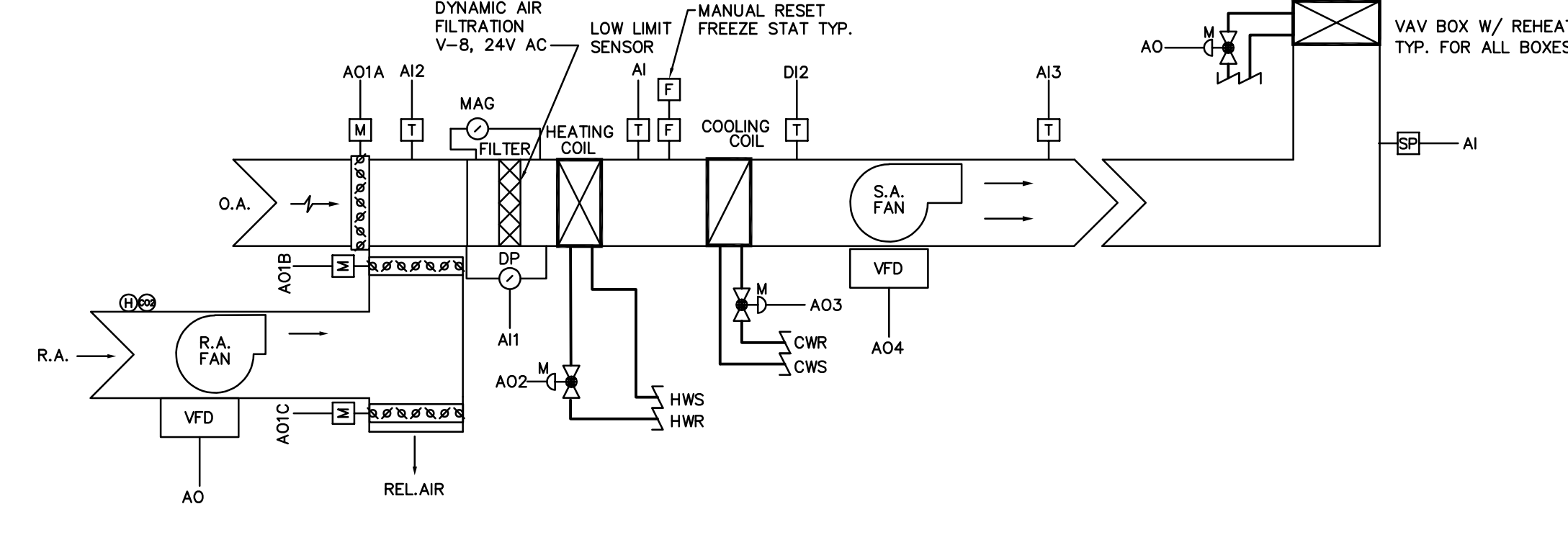
OUTDOOR TEMPERATURE	WATER TEMPERATURE
OF	180F
20F	160F
60F	120F
    - 2. HOT WATER HEATING AND CHILLED WATER PUMP CONTROL TO BUILDING AHUS AND FAN COILS IS EXISTING TO REMAIN.
    - 3. NOTE: THE EXISTING CU-7 AND DX COIL IN AHU-7 IS EXISTING AND THE EXISTING CONTROL SEQUENCE SHALL REMAIN AS IS.
    - 4. AIR HANDLING UNITS 5, 6 (VARIABLE VOLUME)
      - 1. ALL AUTO-CONTROL DAMPERS AND COIL CONTROL VALVES SHALL BE PROVIDED WITH ELECTRIC ACTUATORS. ALL DAMPER AND COIL VALVE ACTUATORS SHALL BE CONTROLLED FROM SEPARATE OUTPUTS.
      - 2. UNIT TO RUN CONTINUOUSLY WHEN ENABLED AS DETERMINED THROUGH DDC CONTROL BUILDING SCHEDULE. WHEN THE UNIT IS OPERATING, THE DDC SYSTEM SHALL OPEN THE RETURN AIR DAMPER AND START THE SUPPLY AIR FAN. THE OUTSIDE AIR AND RELIEF AIR DAMPERS SHALL INITIALLY BE SET AT MINIMUM POSITION. WHEN THE UNIT IS POWERED OFF, THE OUTSIDE AIR DAMPER AND RELIEF AIR DAMPER SHALL BOTH CLOSE AFTER A TIME DELAY OF A MINIMUM OF 30 SECONDS THROUGH A TIME DELAY PROGRAMMED THROUGH THE CONTROLLER.
      - 3. WHEN THE UNIT IS SCHEDULED OFF, THE SUPPLY AIR SHALL BE OFF, AND THE OUTSIDE AND RELIEF AIR DAMPERS SHALL BOTH BE CLOSED. A TEMPERATURE SENSOR DOWNSTREAM OF THE PREHEAT COIL SHALL MODULATE THE HEATING COIL CONTROL VALVE TO MAINTAIN A 50F (ADJUSTABLE) TEMPERATURE INSIDE THE AIR HANDLING UNIT.
      - 4. A DDC STATIC PRESSURE SENSOR LOCATED APPROXIMATELY TWO-THIRDS DOWN THE LENGTH OF THE SUPPLY AIR DUCT RUN WITH THE GREATEST STATIC PRESSURE SHALL MAINTAIN THE MINIMUM DUCT STATIC PRESSURE OF 1.0 (ADJUSTABLE) BY MODULATING THE ADJUSTABLE FREQUENCY DRIVE ON THE SUPPLY FAN. THE STATIC PRESSURE SETPOINT SHALL BE RESET BASED ON ZONE DAMPER POSITION AND AIRFLOW REQUIREMENTS AS DESCRIBED BELOW.
        - a. THE INITIAL DUCT STATIC PRESSURE SETPOINT SHALL BE 1.0 (ADJUSTABLE).
        - b. THE AHU UNIT CONTROLLER SHALL MONITOR THE DAMPER POSITION OF ALL ASSOCIATED VAV TERMINAL UNITS AND DETERMINE EACH VAV CRITICAL ZONE (CZ), WHICH IS THE VAV TERMINAL UNIT THAT HAS THE LOWEST PERCENTAGE OF ACTUAL AIRFLOW COMPARED TO ITS CURRENT OPERATING AIRFLOW SETPOINT.
        - c. WHEN THE CZ DAMPER IS FULLY OPEN AND ACTUAL/SETPOINT AIRFLOW RATIO IS GREATER THAN 95% (EXCESS AIRFLOW/SETPOINT) THE DUCT STATIC PRESSURE SETPOINT SHALL AUTOMATICALLY RESET DOWN BY USE OF PREVIOUS SETPOINT AT A FREQUENCY OF 9 MINUTES TO A MINIMUM OF 0.75 (ADJUSTABLE) OR THE SUPPLY FAN VFD HAS REACHED ITS LOWEST OPERATING SPEED LIMIT.
        - d. WHEN THE CZ DAMPER IS FULLY OPEN AND ACTUAL/SETPOINT AIRFLOW RATIO IS LESS THAN 90% (INSUFFICIENT AIRFLOW/SETPOINT) AND SPACE CO2 IS NOT SATISFIED, THE REVERSE SHALL OCCUR AND THE DUCT STATIC PRESSURE SETPOINT SHALL INCREMENTALLY RESET UP TO A MAXIMUM OF 1.5 (ADJUSTABLE). MONITOR AND ALARM TO DDC SYSTEM IF ANY ZONE CANNOT MAINTAIN AT LEAST 90% OF ACTUAL/SETPOINT AIRFLOW RATIO FOR MORE THAN 30 MINUTES (ADJUSTABLE) IF DUCT STATIC PRESSURE IS AT MAXIMUM SETPOINT.
      - 5. THE STATIC PRESSURE SENSOR LOCATION SHALL BE RECORDED ON THE RECORD CONTROL DRAWINGS AND NOTED ON THE GRAPHIC DISPLAY.
      - 6. STATIC PRESSURE READOUT SHALL BE PROVIDED AT THE OPERATOR'S TERMINAL FOR ALL DUCT STATIC PRESSURE SENSORS. THE DDC SYSTEM SHALL PROVIDE AN ALARM AT THE OPERATOR'S WORKSTATION IF THE SUPPLY AIR DUCT STATIC PRESSURE FALLS 0.2 INCHES (ADJUSTABLE) BELOW SETPOINT.
      - 7. INSTALL A 2-POLE MANUAL RESET HIGH LIMIT STATIC PRESSURE SWITCH IN THE SUPPLY AIR DISCHARGE DUCT TO STOP THE FANS THROUGH THE ELECTRICAL CONTROL CIRCUIT, UPON SENDING A DISCHARGE STATIC PRESSURE ABOVE 4.0 INCHES (ADJUSTABLE). THE DDC SYSTEM SHALL MONITOR THE HIGH STATIC PRESSURE SWITCH AND PROVIDE AN ALARM AT THE OPERATOR'S TERMINAL WHEN TRIPPED.
      - 8. WHEN THE OUTDOOR AIR TEMPERATURE IS 55F (ADJUSTABLE) OR LESS, THE DDC SYSTEM SHALL OPERATE IN ECONOMIZER MODE. CONTROLS SHALL MODULATE THE OUTSIDE AIR, RETURN AIR AND RELIEF AIR DAMPERS TO MAINTAIN A CONSTANT 55F (ADJUSTABLE) SUPPLY AIR TEMPERATURE.
      - 9. WHEN THE OUTDOOR AIR TEMPERATURE EXCEEDS 55F (ADJUSTABLE) THE DDC SYSTEM SHALL OPERATE THE UNIT IN THE COOLING MODE OF OPERATION. CONTROLS SHALL MODULATE THE COOLING COIL VALVE TO MAINTAIN THE SUPPLY AIR TEMPERATURE AT 55F (ADJUSTABLE).
      - 10. A LOW LIMIT DDC TEMPERATURE SENSOR DOWNSTREAM OF THE HEATING COIL SHALL OVERRIDE THE DISCHARGE AIR CONTROL AND MODULATE THE HEATING COIL CONTROL VALVE AS REQUIRED TO MAINTAIN MINIMUM 50F (ADJUSTABLE) AIR TEMPERATURE DOWNSTREAM OF THE HEATING COIL.
      - 11. THE RETURN AIR FAN (RAF-5A, 5B, 6A, 6B) SHALL TRACK THE SUPPLY AIR FAN TO MAINTAIN AN OFFSET BASED ON INITIAL OUTDOOR AIR BALANCE VOLUME.
      - 12. SMOKE DETECTORS SHALL BE PROVIDED BY THE ELECTRICAL CONTRACTOR IN THE RETURN AIR DUCTS OF EACH SYSTEM. SMOKE DETECTORS SHALL BE WIRED TO DEENERGIZE THE SUPPLY AND RETURN FANS THROUGH THE FIRE ALARM SYSTEM.
      - 13. VAV TERMINAL BOXES
        - 1. THE SPACE TEMPERATURE SENSOR AND ASSOCIATED BOX MOUNTED CONTROLLER AND DAMPER ACTUATOR SHALL BE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR. THE HEATING WATER CONTROL VALVE SHALL ALSO BE PROVIDED BY THE TEMPERATURE CONTROL CONTRACTOR AND FURNISHED TO THE HVAC CONTRACTOR FOR INSTALLATION.
        - 2. THE VAV BOX DAMPER WILL MODULATE BETWEEN MINIMUM AND MAXIMUM AIR FLOW SETTINGS TO MAINTAIN THE SPACE TEMPERATURE COOLING SET POINT. AS THE SPACE TEMPERATURE BEGINS TO INCREASE, THE VAV BOX DAMPER WILL MODULATE TOWARDS THE COOLING MINIMUM AIR FLOW SETTING. AS THE SPACE TEMPERATURE CONTINUES TO INCREASE, REACHING THE HEATING SET POINT, THE DAMPER WILL CONTROL TO MAINTAIN THE MINIMUM AIR FLOW SETTING, AND THE REHEAT CONTROL VALVE WILL BEGIN TO OPEN. ONCE THE REHEAT VALVE POSITION REACHES 50%, THE DAMPER WILL BEGIN TO OPEN AND ALLOW MORE AIR INTO THE SPACE. THE DAMPER WILL TRACK ALONG WITH THE REHEAT VALVE UNTIL THE REHEAT MAXIMUM CFM IS REACHED. REHEAT MAXIMUM AIR FLOW IS 50% OF THE COOLING MAXIMUM (ADJUSTABLE). THE VALVE WILL CONTINUE TO OPEN TOWARDS 100% AS NEEDED TO MAINTAIN THE SPACE TEMPERATURE HEATING SET POINT.
        - 3. THE TERMINAL BOX DAMPER ACTUATOR AND HEATING COIL CONTROL VALVE SHALL FAIL TO LAST POSITION ON A LOSS OF POWER TO THE CONTROLLER.
        - 4. EACH TERMINAL BOX SHALL HAVE A SEPARATE SPACE TEMPERATURE SENSOR UNLESS OTHERWISE SHOWN ON THE DRAWINGS.
        - 5. TERMINAL BOXES SERVING MORE THAN ONE SPACE SHALL AVERAGE THE INPUTS FROM ALL SENSORS AND USE THE AVERAGE VALUE TO CONTROL THE BOX. IN AREAS WITH OCCUPANCY SENSORS, WHEN IT IS DETERMINED THE SPACE IS NOT OCCUPIED, THE INPUTS FROM ANY SPACE SENSOR OF THE UNOCCUPIED ZONES SHALL NOT BE USED.
        - 6. TEMPERATURE CONTROL CONTRACTOR SHALL CONNECT TO 120V JUNCTION BOXES AS SHOWN ON THE DRAWINGS AND PROVIDED BY THE ELECTRICAL CONTRACTOR AND PROVIDE TRANSFORMERS AS REQUIRED FOR BOX POWER. ALL WIRING AND TRANSFORMERS FROM THE JUNCTION BOXES TO THE TERMINAL BOXES SHALL BE BY THE TEMPERATURE CONTROL CONTRACTOR.
        - 7. BOX CONTROLLER SHALL PROVIDE SUPPLY AIR VOLUME IN CFM, SUPPLY AIR TEMPERATURE, SPACE TEMPERATURE, AND SPACE TEMPERATURE SETPOINT AT THE OPERATOR'S TERMINAL.
        - 8. PROVIDE DEMAND CONTROLLED VENTILATION PROGRAM THAT REDUCES OUTSIDE DAMPERS TO MINIMUM POSITION WHEN CO2 AS MEASURED IN THE GALLERY SPACES AND IN THE RETURN AIR DUCT IS BELOW 500 PPM. OUTSIDE AIR DAMPER POSITION SHALL BE INCREASED TOWARDS MAXIMUM AS THE CO2 CONCENTRATION IS APPROACHES 1100 PPM.
        - 9. OCCUPANCY SENSORS IN THE GALLERY SPACES SHALL REDUCE THE VAV BOX MINIMUM AIRFLOWS TO 0% WHEN SPACES ARE UNOCCUPIED.
    - B. UNIT HEATER HEATING WATER CONTROL
      - 1. EACH UNIT HEATER SHALL EACH HAVE A LOCAL DDC TEMPERATURE SENSOR.
      - 2. THE THERMOSTAT SETPOINT FOR EACH OF THESE UNITS SHALL BE ADJUSTABLE THROUGH THE BAS, NOT USER ADJUSTABLE.
      - 3. THE BAS SHALL MODULATE THE HEATING 2-WAY OR 3-WAY CONTROL VALVE IN THE UNIT HEATER TO MAINTAIN ROOM SETPOINT TEMPERATURE.

DOC POINTS LISTS

- 1. THE INPUT/OUTPUT POINTS SHALL BE PROVIDED FOR EACH SYSTEM AS SHOWN ON THE P&ID DIAGRAMS AND SCHEDULE. MANY OF THESE POINTS WILL BE REQUIRED TO PROVIDE THE SPECIFIED OPERATING SEQUENCE OF THE RESPECTIVE SYSTEM. OTHERS WILL BE REQUIRED FOR MONITORING PURPOSES ONLY. ALARMS SHALL BE PROVIDED AT THE OPERATOR'S TERMINAL, COORDINATE ALARM SETTINGS WITH OHIO UNIVERSITY'S BUILDING SYSTEMS INTEGRATION MANAGER.

AHU-5, 6 SYSTEM I/O				
TAG	DESCRIPTION	GRAPHICS	TREND	ALARM
AI1	FILTER DIFFERENTIAL PRESSURE TRANSMITTER/GAUGE	X	X	X
AI2	MIXED AIR TEMPERATURE	X	X	X
AI3/4	AHU-5A SUPPLY TEMPERATURE/LOW LIMIT	X	X	X
AI4-AI*	REHEAT COIL AIR TEMPERATURE/ROOM TEMP, HUM, CO2	X	X	X
AO1	AHU-5A OUTSIDE/RETURN/REL. AIR DAMPERS	X		
AO2	AHU-5A-3 HEATING COIL VALVE	X		
AO3/4	AHU-5A SUPPLY FAN/RETURN FAN SPEED	X		
AO5-AO*	REHEAT COIL VALVES/HUMIDIFIER	X		
MAQ	STANDARD MAGNETIC GAUGE- 0" TO 3" RANGE	PHYSICAL GAUGE		
DI2	LOW LIMIT TEMPERATURE SENSOR	X		X
DO1	RUNAROUND PUMP START/STOP	X		X

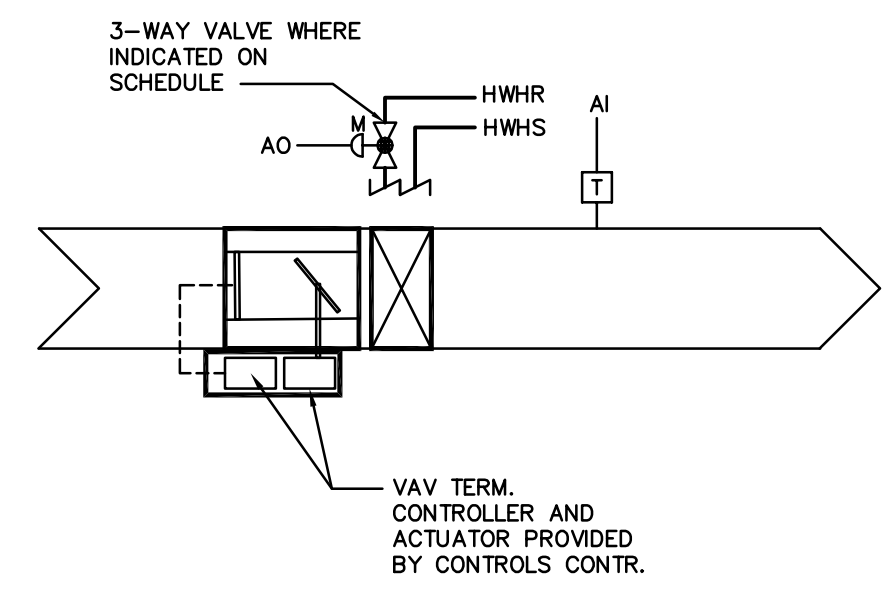
\* REFER TO AIR TERMINAL SCHEDULE FOR LIST OF VAV BOXES



1 AHU CONTROL DIAGRAM - AHU-5, 6

AHU-5A, 5B, 6A, 6B SYSTEM I/O				
TAG	DESCRIPTION	GRAPHICS	TREND	ALARM
AI1	FLOW DIFFERENTIAL PRESSURE INPUT TO TRANSDUCER	X	X	X
AI2	DISCHARGE AIR TEMPERATURE	X	X	X
AI4-AI*	REHEAT COIL AIR TEMPERATURE	X	X	X
AO1	DOAS-3 OUTSIDE/RETURN/REL. AIR DAMPERS	X		
AO2	DOAS-3 HEATING COIL VALVE	X		
AO3	DOAS-3 SUPPLY FAN VFD SPEED	X		
AO5-AO*	REHEAT COIL VALVES	X		X
DI2	LOW LIMIT TEMPERATURE SENSOR	X		X
DO1	RUNAROUND PUMP START/STOP	X		X

\* REFER TO AIR TERMINAL SCHEDULE FOR LIST OF VAV BOXES



2 VAV TERMINAL UNIT CONTROL DIAGRAM - SEE SCHEDULE

H7-23069.DWG

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PROFESSIONAL SEAL

STATE OF OHIO  
TIM PRATER  
E-51932  
REGISTERED PROFESSIONAL ENGINEER  
9/9/24

ISSUE DATES

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE

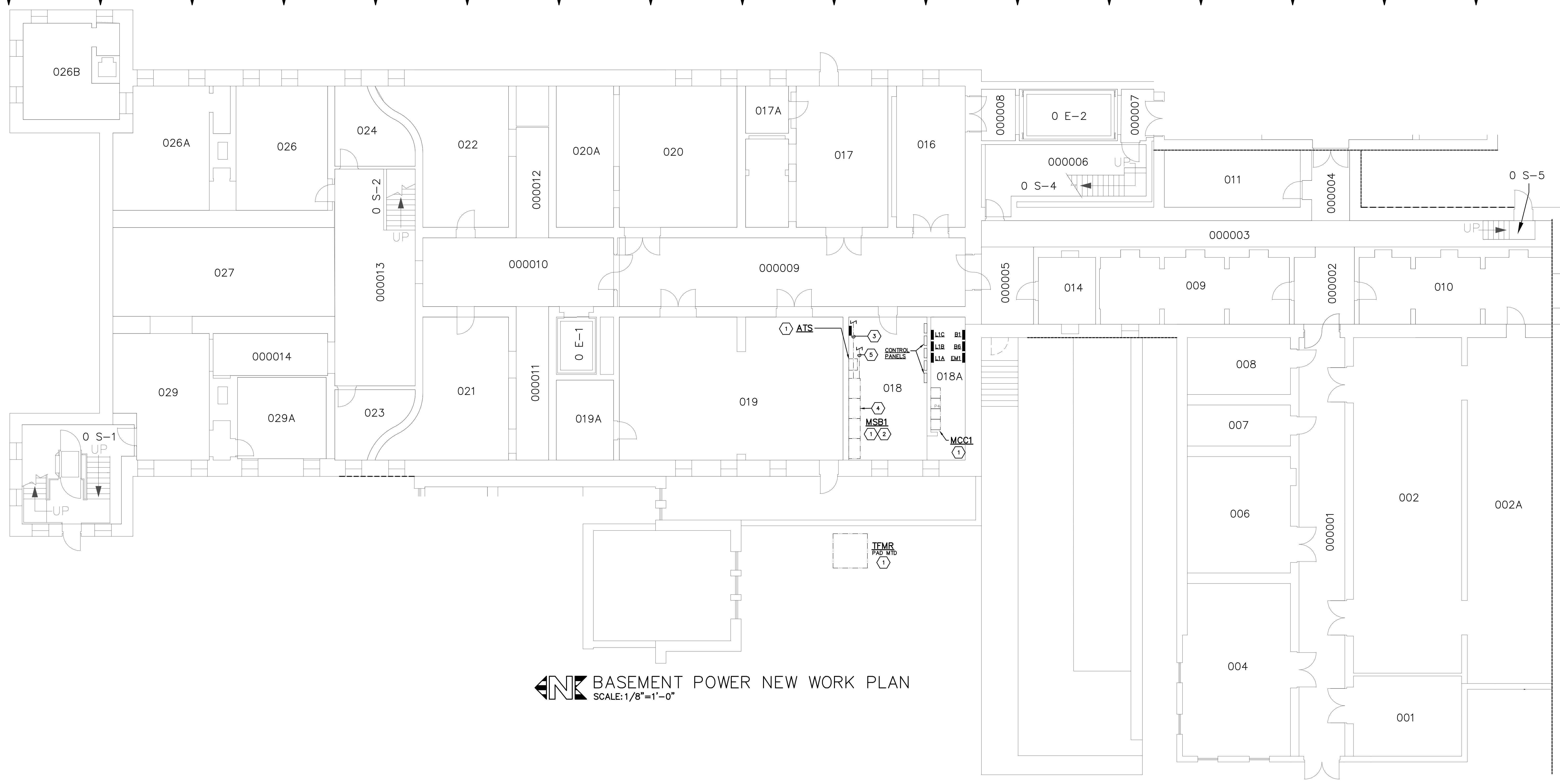
OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701

PROJECT NUMBER: 23002  
DATE: 10/31/23 DRAWN:

SHEET TITLE  
HVAC SCHEMATICS  
AND DETAILS

SHEET  
**H-7**

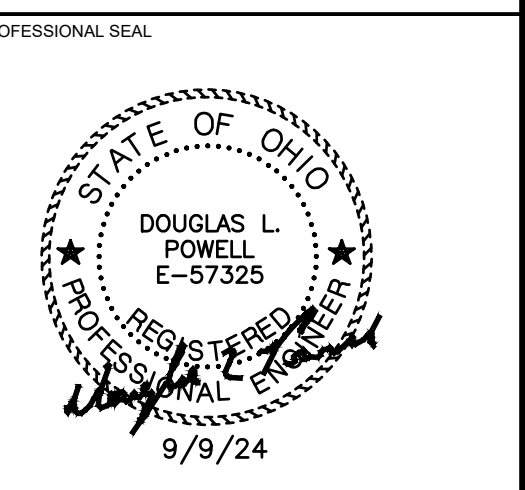




**BASEMENT POWER NEW WORK PLAN**  
 SCALE: 1/8"=1'-0"

- CODED NOTES**
- EXISTING TO REMAIN UNLESS NOTED OTHERWISE. SHOWN FOR REFERENCE ONLY.
  - SEE ONE LINE DIAGRAMS ON SHEET E5 FOR MORE INFORMATION.
  - EXISTING 200A FEEDER SERVING PANEL 2B TO BE INTERCEPTED ON SECOND FLOOR AND EXTENDED TO NEW PANEL 3B ON THIRD FLOOR.
  - DISCONNECT AND REMOVE EXISTING 100A FEEDER SERVING PANEL 3A AND PANEL 4A. EXISTING 100A SWITCH AND FUSES IN THIS SECTION TO BE REUSED FOR PANEL 2B.
  - RUN NEW 100A FEEDER FOR PANEL 2B IN 2" SPARE CONDUIT. REWORK CONDUIT AS REQUIRED.

- GENERAL NOTES**
- ALL EQUIPMENT SHOWN ON THIS PLAN IS EXISTING TO REMAIN UNLESS NOTED OTHERWISE.
  - COORDINATE WITH ALL OTHER DISCIPLINES FOR RELATED ELECTRICAL WORK REQUIRED UNDER DIVISIONS 23.
  - EQUIPMENT AND PIPING SHALL HAVE PRECEDENCE OVER PLACEMENT OF DISCONNECT SWITCH AND/OR VFD. COORDINATE WITH OTHER TRADES IN FIELD PRIOR TO ROUGH-IN. MAKE MINOR ADJUSTMENT TO MOUNTING LOCATION OR HEIGHT AS REQUIRED.
  - THE ELECTRICAL CONTRACTOR IS TO PROVIDE ALL ADDITIONAL STEEL HANGERS, RODS, CLAMPS, ETC., AS REQUIRED FOR PROPER INSTALLATION AND SUPPORT OF NEW WORK.
  - THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FIRE STOPPING AT ALL ELECTRICAL RELATED PENETRATIONS OF FIRE, SMOKE AND OTHER RATED STRUCTURES, INCLUDING FLOORS, WALLS, PARTITIONS, ETC..



ISSUE DATES

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
 DATE: 10/31/23 DRAWN

SHEET TITLE  
**BASEMENT  
 POWER PLANS**

SHEET  
**E0**

EO-23069.DWG

**PRATER**  
**Engineering Associates, Inc.**

6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com

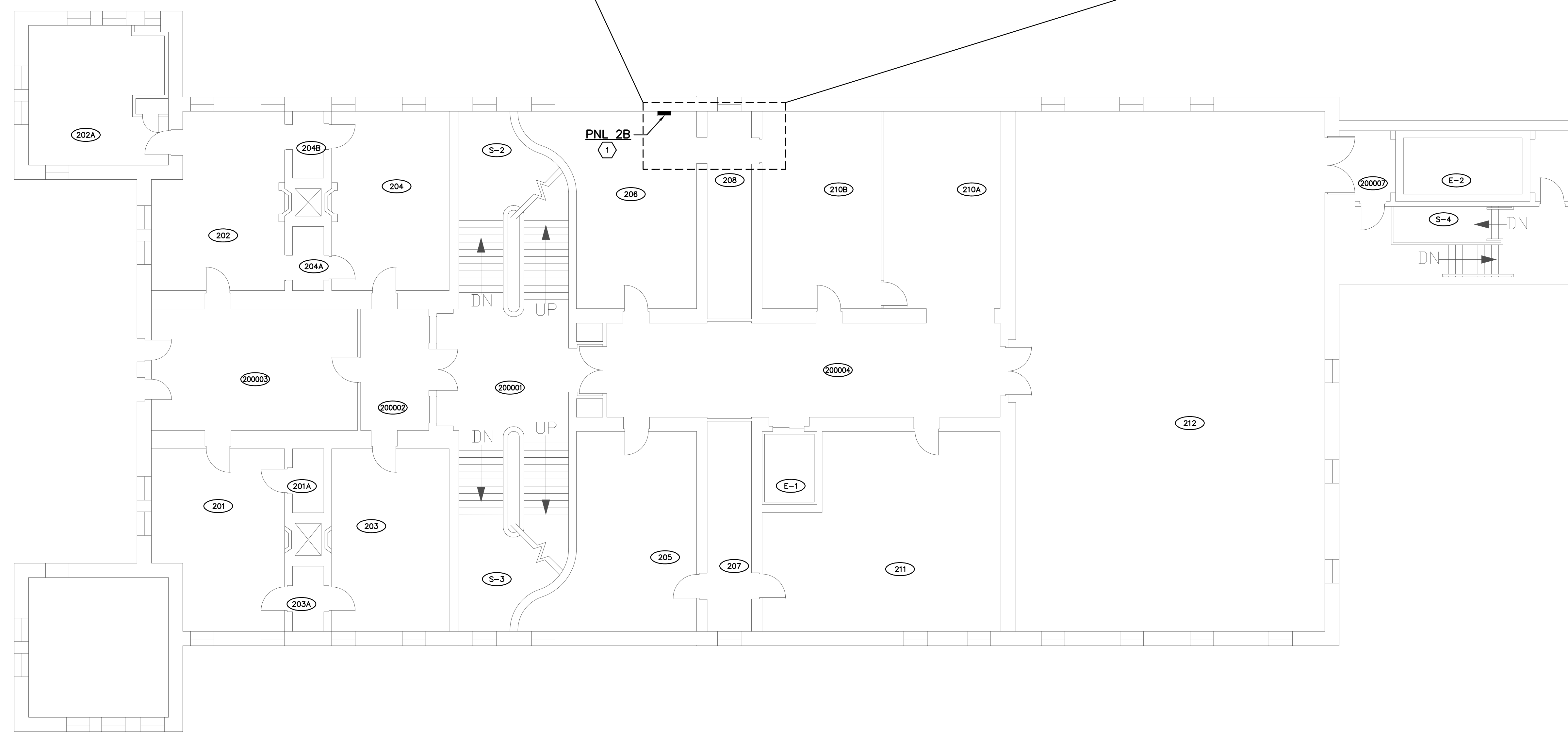
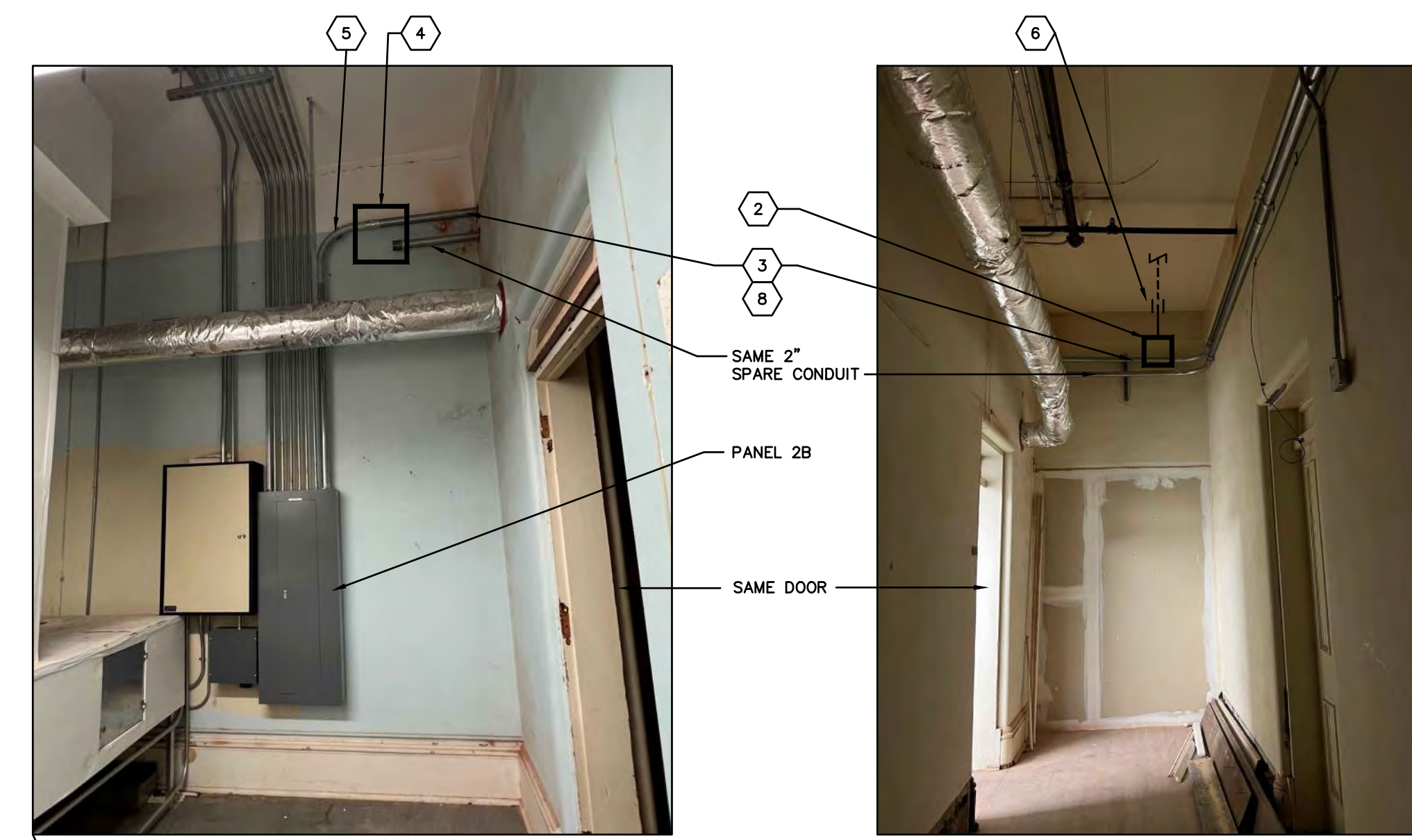
DESIGNED BY C. TONG	DRAWN BY DUP	CHECKED BY DUP	JOB NBR 23069
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### GENERAL NOTES

- A. COORDINATE WITH ALL OTHER DISCIPLINES FOR RELATED ELECTRICAL WORK REQUIRED UNDER DIVISIONS 22 & 23.
- B. EQUIPMENT AND PIPING SHALL HAVE PRECEDENCE OVER PLACEMENT OF DISCONNECT SWITCH AND/OR VFD. COORDINATE WITH OTHER TRADES IN FIELD PRIOR TO ROUGH-IN. MAKE MINOR ADJUSTMENT TO MOUNTING LOCATION OR HEIGHT AS REQUIRED.
- C. THE ELECTRICAL CONTRACTOR IS TO PROVIDE ALL ADDITIONAL STEEL HANGERS, RODS, CLAMPS, ETC., AS REQUIRED FOR PROPER INSTALLATION AND SUPPORT OF NEW WORK.
- D. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FIRE STOPPING AT ALL ELECTRICAL RELATED PENETRATIONS OF FIRE, SMOKE AND OTHER RATED STRUCTURES, INCLUDING FLOORS, WALLS, PARTITIONS, ETC..
- E. REFER TO ONE LINE DIAGRAMS ON SHEET E5 FOR MORE INFO.

### CODED NOTES

- 1. EXISTING PANEL TO BE REFEED FROM NEW 100A POWER SOURCE. ALL BRANCH CIRCUITS TO REMAIN. SEE PHOTOS ON THIS SHEET FOR MORE INFO.
- 2. PROVIDE SPLICE BOX FOR SPLICING OF EXISTING FEEDER FOR PANEL 2B. SIZE PER NEC.
- 3. INTERCEPT EXISTING FEEDER FOR PANEL 2B (2" CONDUIT) IN THE HALLWAY OUTSIDE OF MECH ROOM (SEE IMAGE ON THE RIGHT). SPLICE EXISTING 200A FEEDER FROM MSB IN BASEMENT WITH NEW AND EXTEND TO NEW PANEL 2B ON THIRD FLOOR. REMOVE SURPLUS FEEDER FROM SPLICE BOX TO PANEL 2B.
- 4. PROVIDE SPLICE BOX LARGE ENOUGH FOR THE EXISTING PANEL 2B FEEDER CONDUIT AND SPARE CONDUIT TO TERMINATE ON.
- 5. RUN NEW 100A FEEDER FROM MSB ON BASEMENT TO PANEL 2B, THROUGH SPARE CONDUIT, SPLICE BOX AND EXISTING FEEDER CONDUIT. IF DESIRED, CONTRACTOR COULD RUN NEW CONDUIT FROM SPLICE BOX TO PANEL 2B.
- 6. PROVIDE CORING THROUGH CEILING/FLOOR FOR NEW FEEDER CONDUIT. SCHEDULE CORING WORK WITH UNIVERSITY.



**ANZ** SECOND FLOOR POWER PLAN  
SCALE: 1/8"=1'-0"

PROFESSIONAL SEAL  
STATE OF OHIO  
DOUGLAS L. POWELL  
E-57325  
Professional Engineer  
9/9/24

ISSUE DATES		
NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701

PROJECT NUMBER: 23002  
DATE: 10/31/23 DRAWN

SHEET TITLE  
SECOND FLOOR  
POWER PLAN

SHEET  
**E2**

E2-23069.DWG

**PRATER**  
Engineering Associates, Inc.

6130 Wilcox Road (614) 766 4896  
Dublin, Ohio 43016 praterengineering.com

DESIGNED BY C. TONG	DRAWN BY DKT	CHECKED BY DUP	JOB N/A 23069
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**GENERAL NOTES**

- A. COORDINATE WITH ALL OTHER DISCIPLINES FOR RELATED ELECTRICAL WORK REQUIRED UNDER DIVISIONS 22 & 23.
- B. EQUIPMENT AND PIPING SHALL HAVE PRECEDENCE OVER FIELD PRIOR TO ROUGH-IN. MAKE MINOR ADJUSTMENT TO MOUNTING LOCATION OR HEIGHT AS REQUIRED.
- C. THE ELECTRICAL CONTRACTOR IS TO PROVIDE ALL ADDITIONAL STEEL HANGERS, RODS, CLAMPS, ETC. AS REQUIRED FOR PROPER INSTALLATION AND SUPPORT OF NEW WORK.
- D. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FIRE STOPPING AT ALL ELECTRICAL RELATED PENETRATIONS OF FIRE, SMOKE AND OTHER RATED STRUCTURES, INCLUDING FLOORS, WALLS, PARTITIONS, ETC.

**CODED NOTES**

1. EXISTING TO REMAIN. SHOWN FOR REFERENCE ONLY.
2. EXISTING AIR HANDLER TO BE REMOVED BY MECH CONTRACTOR. THIS CONTRACTOR TO DISCONNECT AND REMOVE DISC SWITCH, REMOVE ASSOCIATED ACCESSIBLE CONDUITS AND WIRES (FOR POWER AND DUCT SMOKE DETECTOR) BACK TO SOURCE.
3. EXISTING PANEL TO REMAIN AND BE REFEED FROM NEW POWER SOURCE. FEEDER FROM MSB IN BASEMENT IS SPICED WITH THAT OF PANEL 3A IN THIS PANEL. REMOVE FEEDER FROM MSB, PROTECT FEEDER FOR PANEL 4A FOR SPICE WITH NEW FEEDER. SEE PHOTO ON THIS SHEET FOR EXISTING CONDITION. ALL EXISTING BRANCH CIRCUITS SHALL REMAIN EXCEPT THOSE SERVING RECEPTACLES AND LIGHTING IN EXISTING ROOMS 306, 306A, 306B AND 306. SEE PHOTO ON THIS SHEET FOR EXISTING CONDITION.
4. ALL DEVICES, LIGHT FIXTURE, AND DISCONNECT SWITCH, ETC. SHOWN IN THIS ROOM ARE EXISTING TO REMAIN UNLESS NOTED OTHERWISE.
5. DISCONNECT AND REMOVE EXISTING LIGHTING FIXTURES. REMOVE ASSOCIATED CONDUIT AND WIRES BACK TO SOURCE. REMOVE ASSOCIATED LIGHT SWITCHES, IF LIGHT SWITCHES) ALSO REMOVE LIGHTING FIXTURES BEYOND AREA OF DEMOLITION. PROVIDE JUNCTION TO MAINTAIN CONTROL TO EXISTING TO REMAIN FIXTURES. CONTRACTOR TO VERIFY IN FIELD.
6. UNDER ALTERNATE H-2, PROVIDE DISC SWITCH AND CIRCUIT FOR ELECTRIC HUMIDIFIER. COORDINATE MOUNTING LOCATION WITH MECH CONTRACTOR IN FIELD PRIOR TO ROUGH-IN. MAKE FINAL CONNECTION TO EQUIPMENT.
7. PROVIDE 120V, 20A CIRCUIT AT FOUR TO SIX LOCATIONS FOR VAV CONTROLS. 24V TRANSFORMER AND WIRING FURNISHED BY TEMP CONTROL CONTRACTOR. COORDINATE EXACT LOCATIONS FOR WHERE 120V CIRCUITS ARE NEEDED WITH T.C.C. IN FIELD PRIOR TO ROUGH-IN.
8. NEW FEEDER FOR PNL 3A SHALL ENTER THROUGH THE OPENING IN WALL AND THE BACK OF PNL 3A (AFTER THE REMOVAL OF DISC SWITCH). PROVIDE LUGS TO SPICE NEW FEEDER WITH THE EXISTING FEEDER FOR PNL 4A. SEE PHOTO ON THIS SHEET FOR EXISTING CONDITION. NEW FEEDER CONDUIT FROM PANEL 3B SHALL BE SECURED TO CEILING/STRUCTURE ABOVE PRIOR TO TURNING DOWN TO PANEL 3A. PROVIDE MINIMUM ONE (1) PULL BOX (NOT SHOWN ON FLOOR PLAN). LOCATION TO BE DETERMINED BY E.C. BASED ON EXISTING FIELD CONDITION AND NUMBERS OF 90° TURNS ON NEW CONDUIT.
9. DISC SWITCH FURNISHED WITH UNIT HEATER BY MECH CONTRACTOR.
10. VFD FURNISHED BY MECH CONTRACTOR, INSTALLED AND WIRED BY ELEC CONTRACTOR. COORDINATE WITH MECH CONTRACTOR IN FIELD.
11. EXISTING TO BE REMOVED.
12. COORDINATE LIGHT FIXTURES MOUNTING HEIGHT AND LOCATION WITH HVAC EQUIPMENT AND DUCTWORK IN THIS ROOM. DUCTWORK SHALL HAVE PRECEDENCE OVER LIGHT FIXTURES. LIGHT FIXTURES MOUNTING HEIGHT SHALL BE MINIMUM 8'-0" A.F.F. MOUNT BELOW DUCT WORK AS NECESSARY. COORDINATE WITH MECH CONTRACTOR IN FIELD.
13. EXTEND FEEDER CONDUIT FROM SECOND FLOOR TO NEW PANEL 3B IN ROOM 305. RUN CONDUIT ALONG WALL AND CEILING.
14. PROVIDE CORING ON CEILING ABOVE PANEL 3B, AND RUN FEEDER TO PANEL 4B. SCHEDULE CORING WORK WITH UNIVERSITY.
15. COORDINATE AIR FILTER BOX LOCATION AND TERMINATION WITH MECH CONTRACTOR IN FIELD.



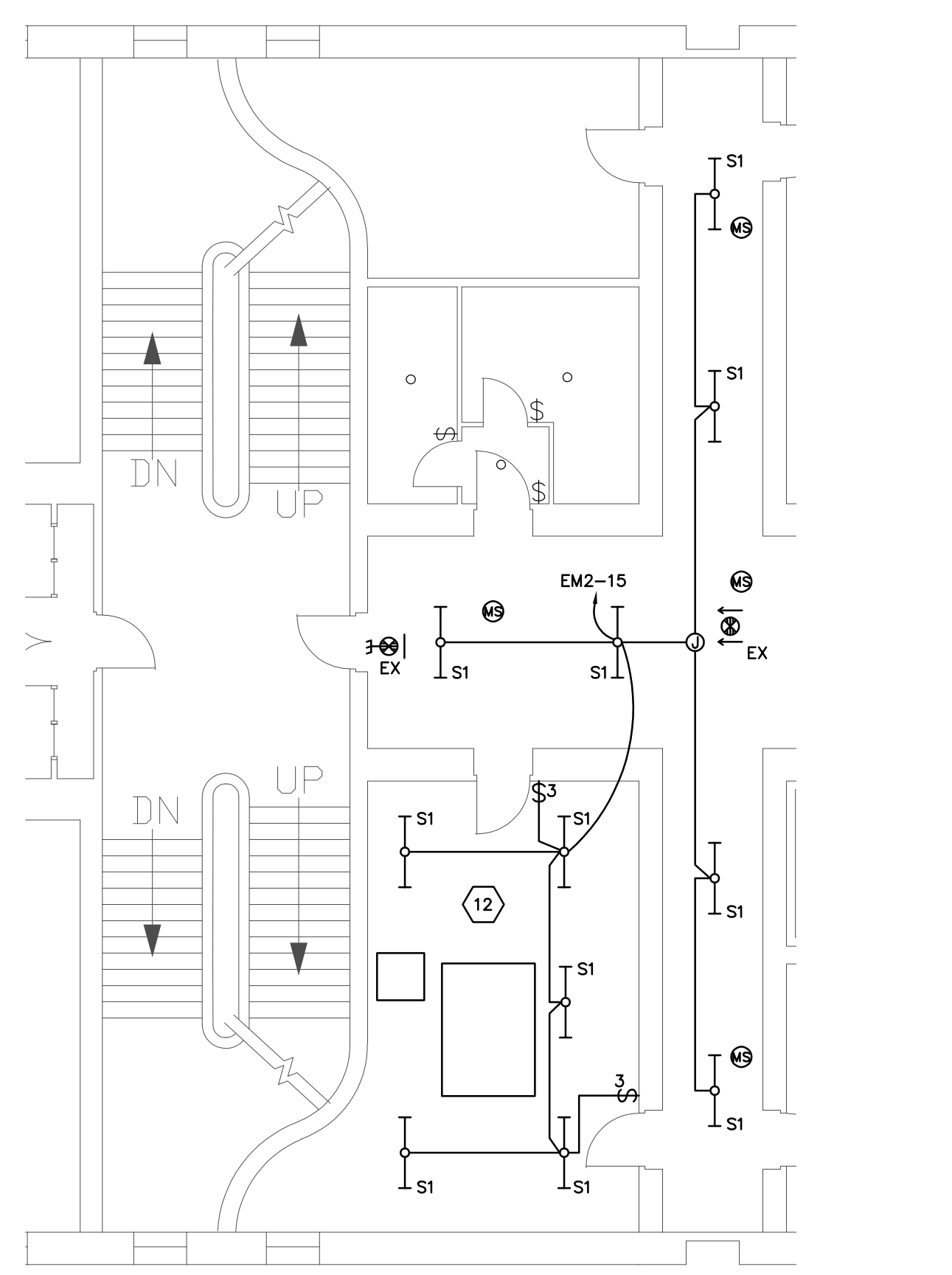
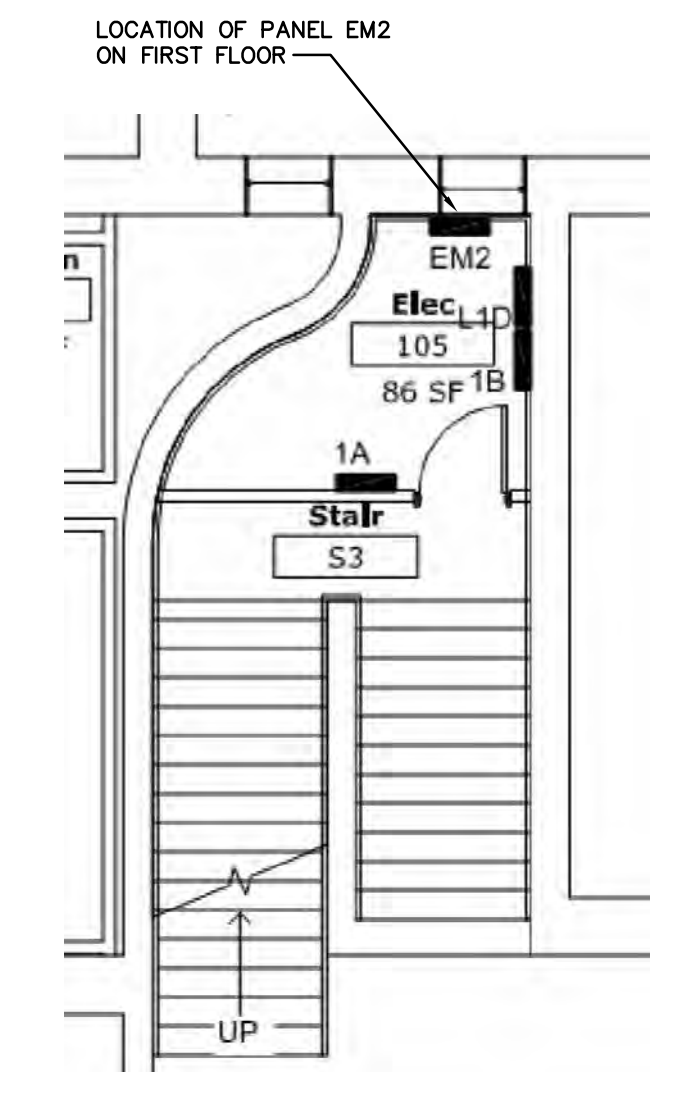
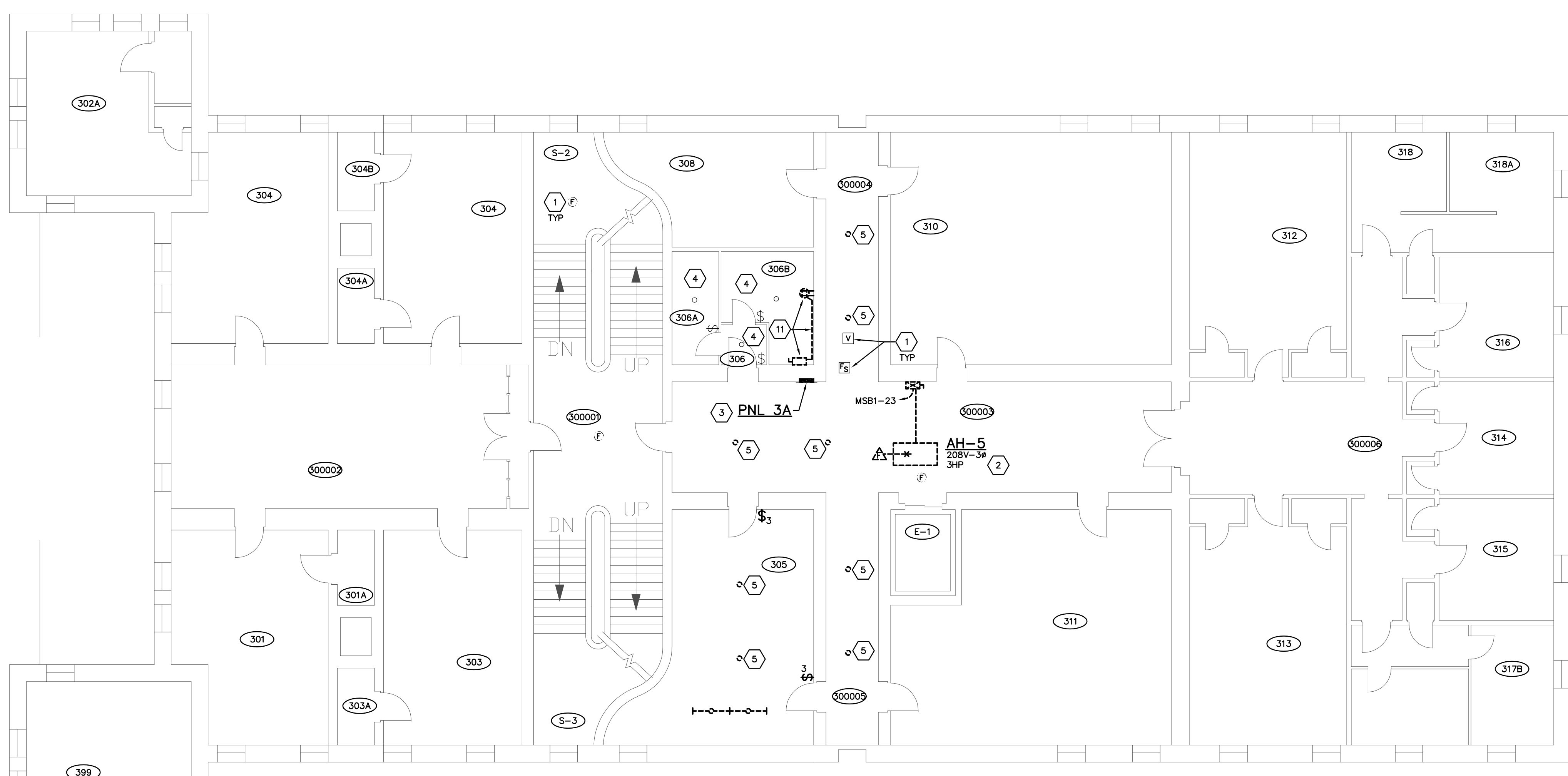
**PANEL 3A**  
 FEEDER TO PANEL 4A  
 FEEDER FROM MSB  
 FEEDER SPICE  
**ALT.-H2 NOTES**



**DISC SWITCH**  
 FED FROM PANEL 3A  
 (IN ROOM 306B)  
 NEW FEEDER FOR PANEL 3A SHALL ENTER THROUGH WALL OPENING AFTER THE REMOVAL OF DISC SWITCH.

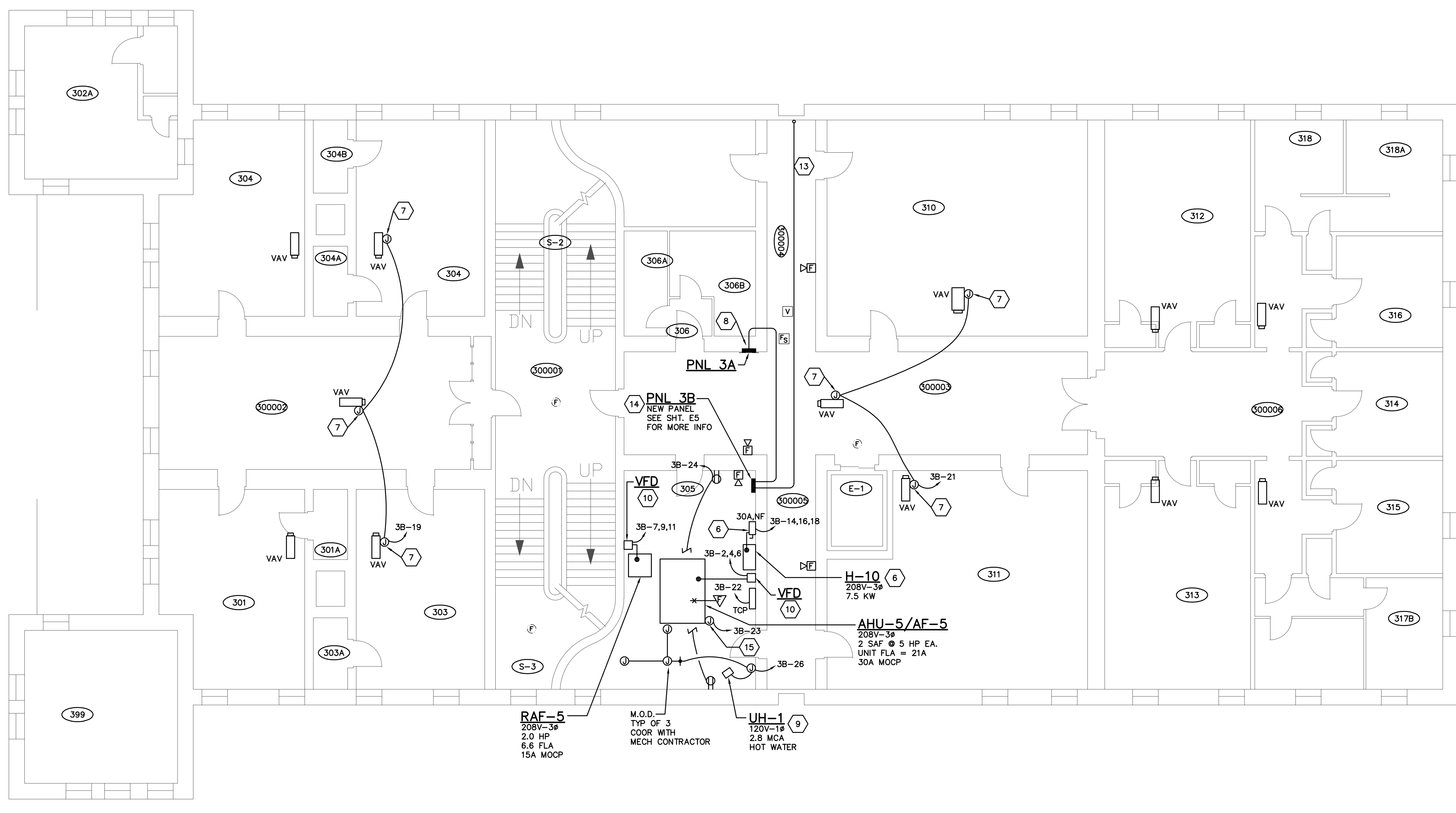
**ALT.-H1 NOTES**

**THIRD FLOOR ELECTRICAL DEMOLITION PLAN**  
 SCALE: 1/8"=1'-0"



**PARTIAL THIRD FLOOR LIGHTING PLAN - NEW WORK**  
 SCALE: 1/8"=1'-0"

**THIRD FLOOR POWER PLAN - NEW WORK**  
 SCALE: 1/8"=1'-0"



PROFESSIONAL SEAL  
  
 9/9/24

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
 DATE: 10/31/23  
 SHEET TITLE  
**THIRD FLOOR  
 POWER PLAN**

E3-23069.DWG  
**PRATER**  
 Engineering Associates, Inc.  
 6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com  
 DESIGNED BY C. TONG DRAWN BY DJP CHECKED BY JOB NIM 23069

**E3**

**GENERAL NOTES**

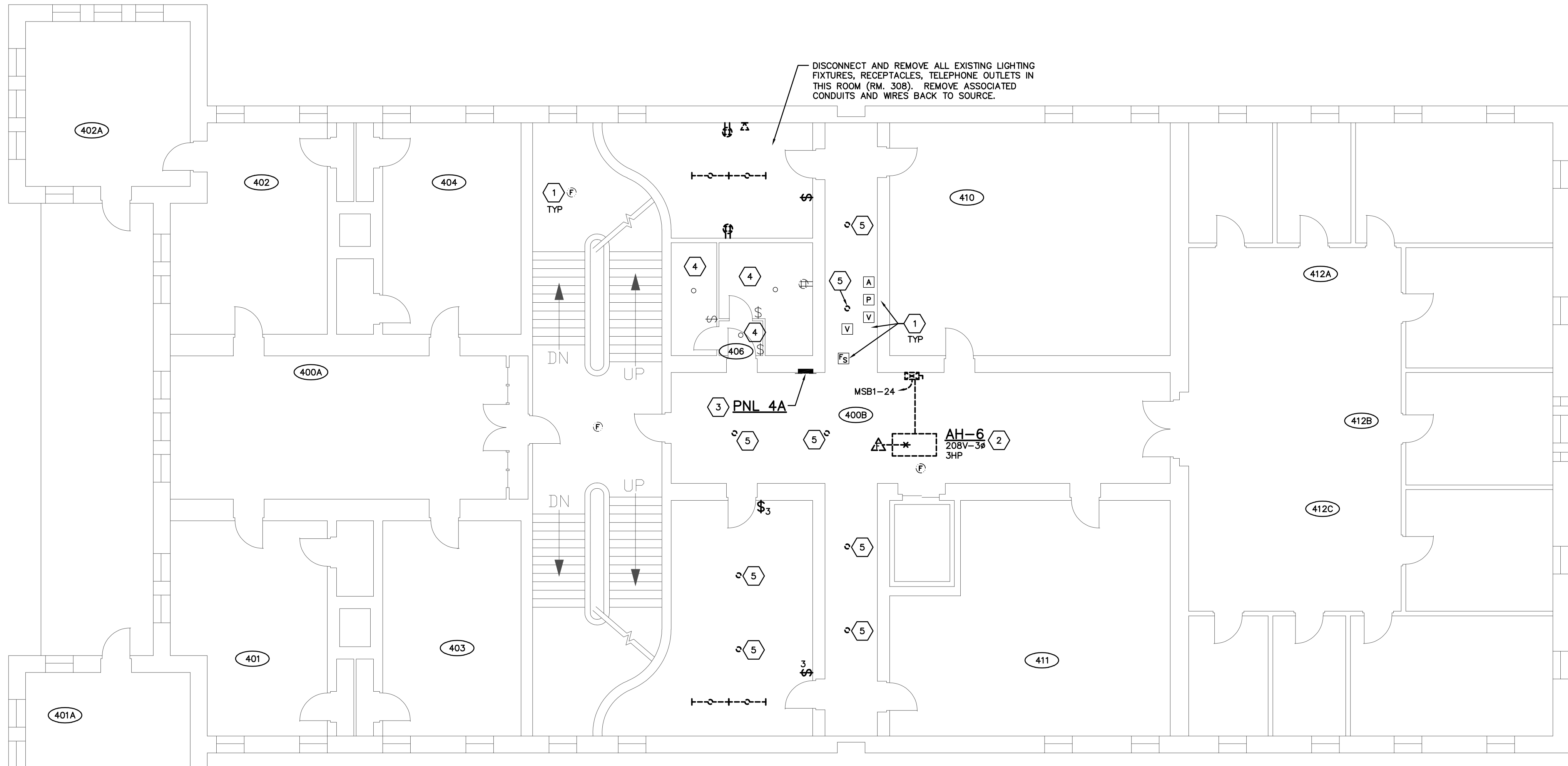
- A. COORDINATE WITH ALL OTHER DISCIPLINES FOR RELATED ELECTRICAL WORK REQUIRED UNDER DIVISIONS 22 & 23.
- B. EQUIPMENT AND PIPING SHALL HAVE PRECEDENCE OVER PLACEMENT OF DISCONNECT SWITCH AND/OR VFD. COORDINATE WITH OTHER TRADES IN FIELD PRIOR TO ROUGH-IN. MAKE MINOR ADJUSTMENT TO MOUNTING LOCATION OR HEIGHT AS REQUIRED.
- C. THE ELECTRICAL CONTRACTOR IS TO PROVIDE ALL ADDITIONAL STEEL HANGERS, RODS, CLAMPS, ETC., AS REQUIRED FOR PROPER INSTALLATION AND SUPPORT OF NEW WORK.
- D. THE ELECTRICAL CONTRACTOR IS RESPONSIBLE FOR FIRE STOPPING AT ALL ELECTRICAL RELATED PENETRATIONS OF FIRE, SMOKE AND OTHER RATED STRUCTURES, INCLUDING FLOORS, WALLS, PARTITIONS, ETC.

**CODED NOTES**

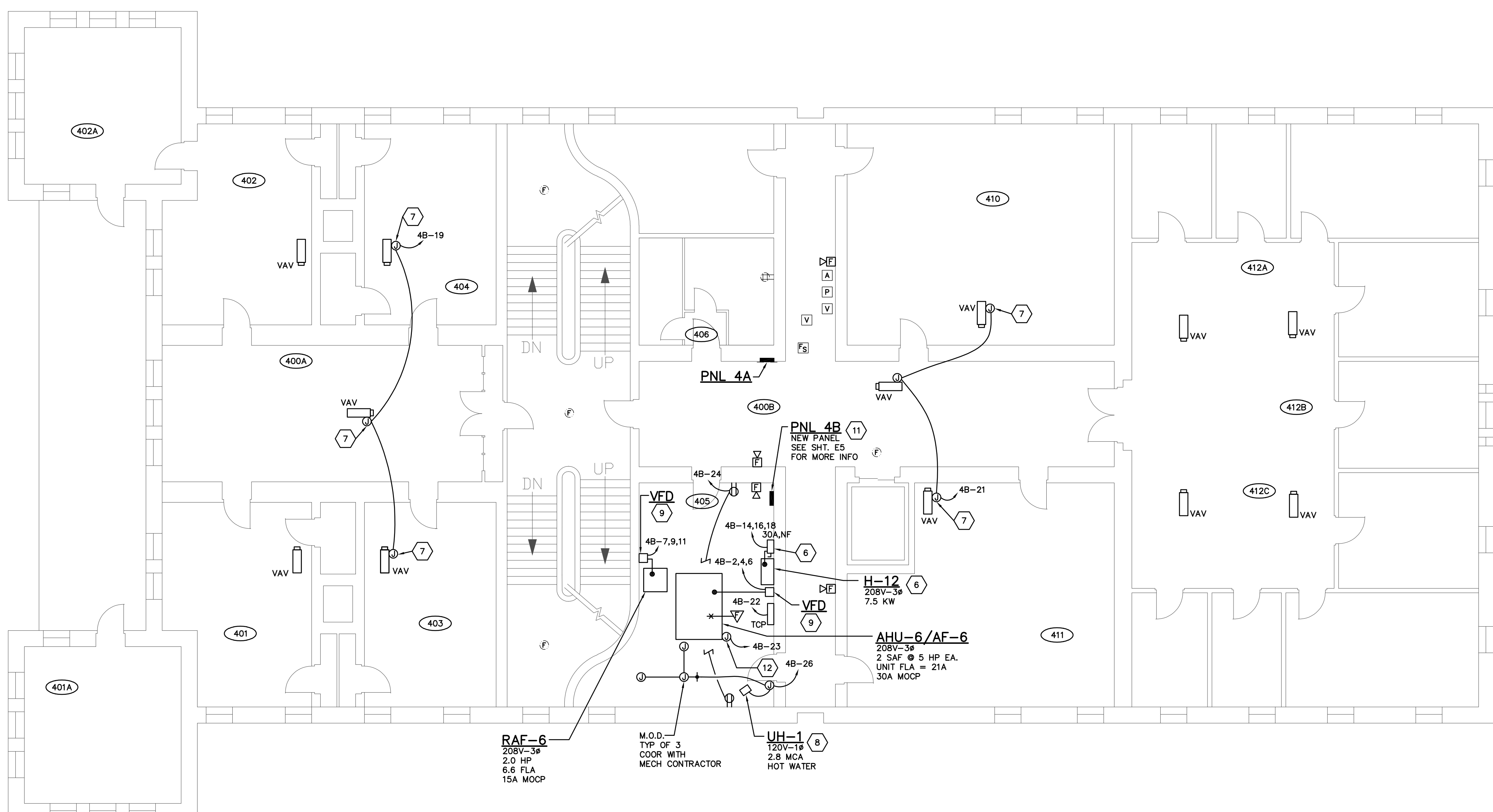
- 1. EXISTING TO REMAIN. SHOWN FOR REFERENCE ONLY.
- 2. EXISTING AIR HANDLER TO BE REMOVED BY MECH CONTRACTOR. THIS CONTRACTOR TO DISCONNECT AND REMOVE DISC SWITCH, REMOVE ASSOCIATED ACCESSIBLE CONDUITS AND WIRES (FOR POWER AND DUCT SMOKE DETECTOR) BACK TO SOURCE.
- 3. EXISTING PANEL TO REMAIN. SEE SHEETS E5 AND E6 FOR MORE INFO.
- 4. ALL DEVICES, LIGHT FIXTURE, AND DISCONNECT SWITCH, ETC. SHOWN IN THIS ROOM ARE EXISTING TO REMAIN UNLESS NOTED OTHERWISE.
- 5. DISCONNECT AND REMOVE EXISTING LIGHTING FIXTURES. REMOVE ASSOCIATED CONDUIT AND WIRES BACK TO SOURCE.
- 6. UNDER ALTERNATE H-2, PROVIDE DISC SWITCH AND CIRCUIT FOR ELECTRIC HUMIDIFIER. COORDINATE MOUNTING LOCATION WITH MECH CONTRACTOR IN FIELD PRIOR TO ROUGH-IN. MAKE FINAL CONNECTION TO EQUIPMENT.
- 7. PROVIDE 120V, 30A CIRCUIT AT FOUR TO SIX LOCATIONS FOR VAV CONTROLS. 24V TRANSFORMER AND WIRING FURNISHED BY TEMP CONTROL CONTRACTOR. COORDINATE EXACT LOCATIONS FOR WHERE 120V CIRCUITS ARE NEEDED WITH T.C.C. IN FIELD PRIOR TO ROUGH-IN.
- 8. DISC SWITCH FURNISHED WITH UNIT HEATER BY MECH CONTRACTOR.
- 9. VFD FURNISHED BY MECH CONTRACTOR, INSTALLED AND WIRED BY ELEC CONTRACTOR. MAKE FINAL CONNECTIONS TO FANS. COORDINATE WITH MECH CONTRACTOR IN FIELD.
- 10. COORDINATE LIGHT FIXTURES MOUNTING HEIGHT AND LOCATION WITH HVAC EQUIPMENT AND DUCTWORK IN THIS ROOM. DUCTWORK SHALL HAVE PRECEDENCE OVER LIGHT FIXTURES. LIGHT FIXTURES MOUNTING HEIGHT SHALL BE MINIMUM 8'-0" A.F.F. MOUNT BELOW DUCT WORK AS NECESSARY. COORDINATE WITH MECH CONTRACTOR IN FIELD.
- 11. PANEL 4B IS FED FROM PANEL 3B ON THIRD FLOOR.
- 12. COORDINATE AIR FILTER BOX LOCATION AND TERMINATION WITH MECH CONTRACTOR IN FIELD.

ALT.-H2 NOTES

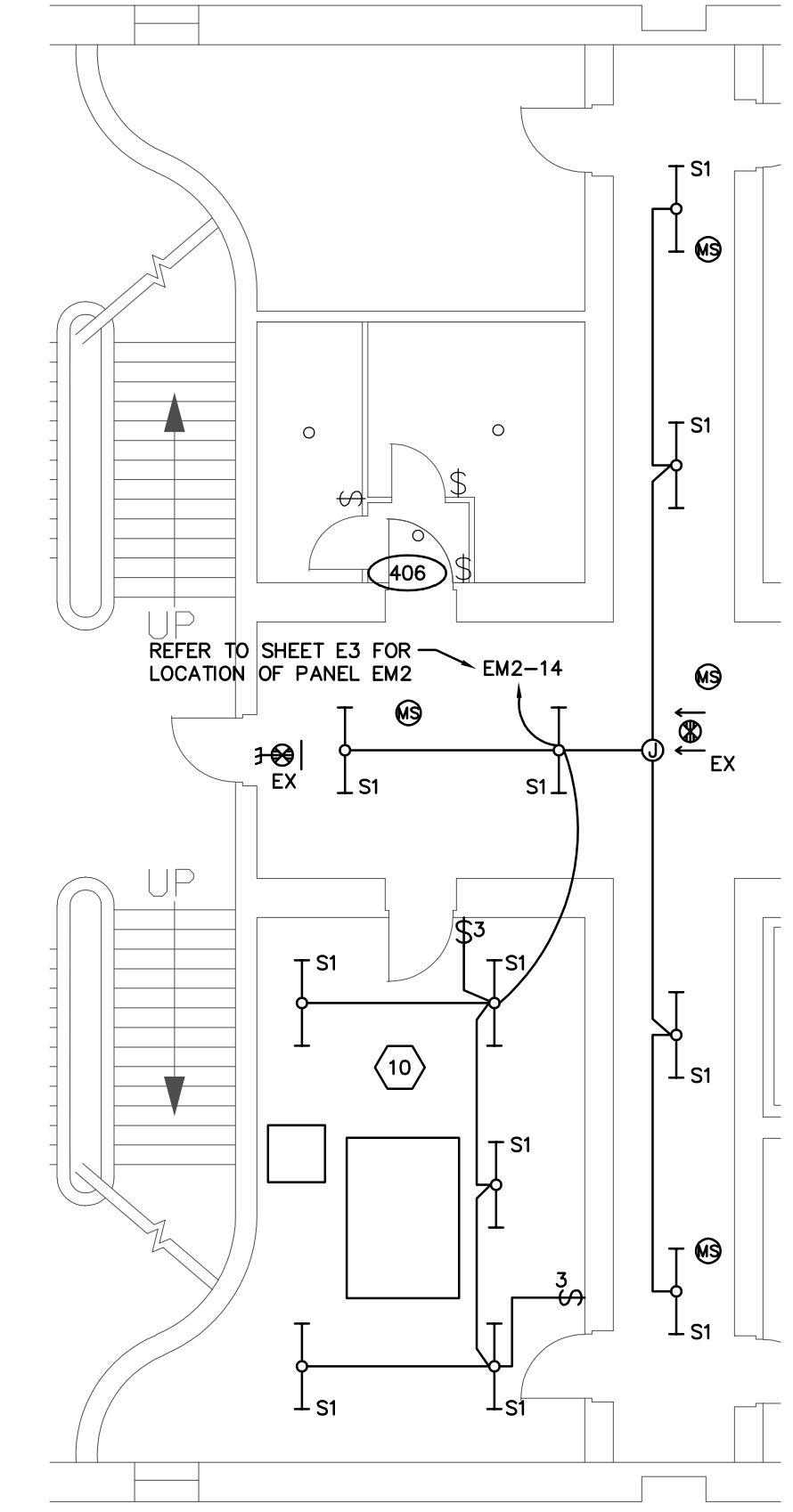
ALT.-H1 NOTES



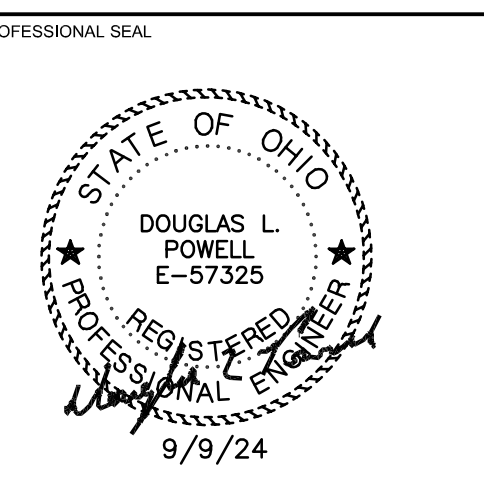
**FOURTH FLOOR ELECTRICAL DEMOLITION PLAN**  
 SCALE: 1/8"=1'-0"



**FOURTH FLOOR POWER PLAN - NEW WORK**  
 SCALE: 1/8"=1'-0"



**PARTIAL FOURTH FLOOR LIGHTING PLAN - NEW WORK**  
 SCALE: 1/8"=1'-0"



ISSUE DATES

NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE

OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701

PROJECT NUMBER: 23002

DATE: 10/31/23

SHEET TITLE: FOURTH FLOOR POWER PLAN

E4-23069.DWG

**PRATER**  
 Engineering Associates, Inc.

8130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com

DESIGNED BY: C. TONG    DRAWN BY: DJP    CHECKED BY: DJP    JOB N/A: 23069

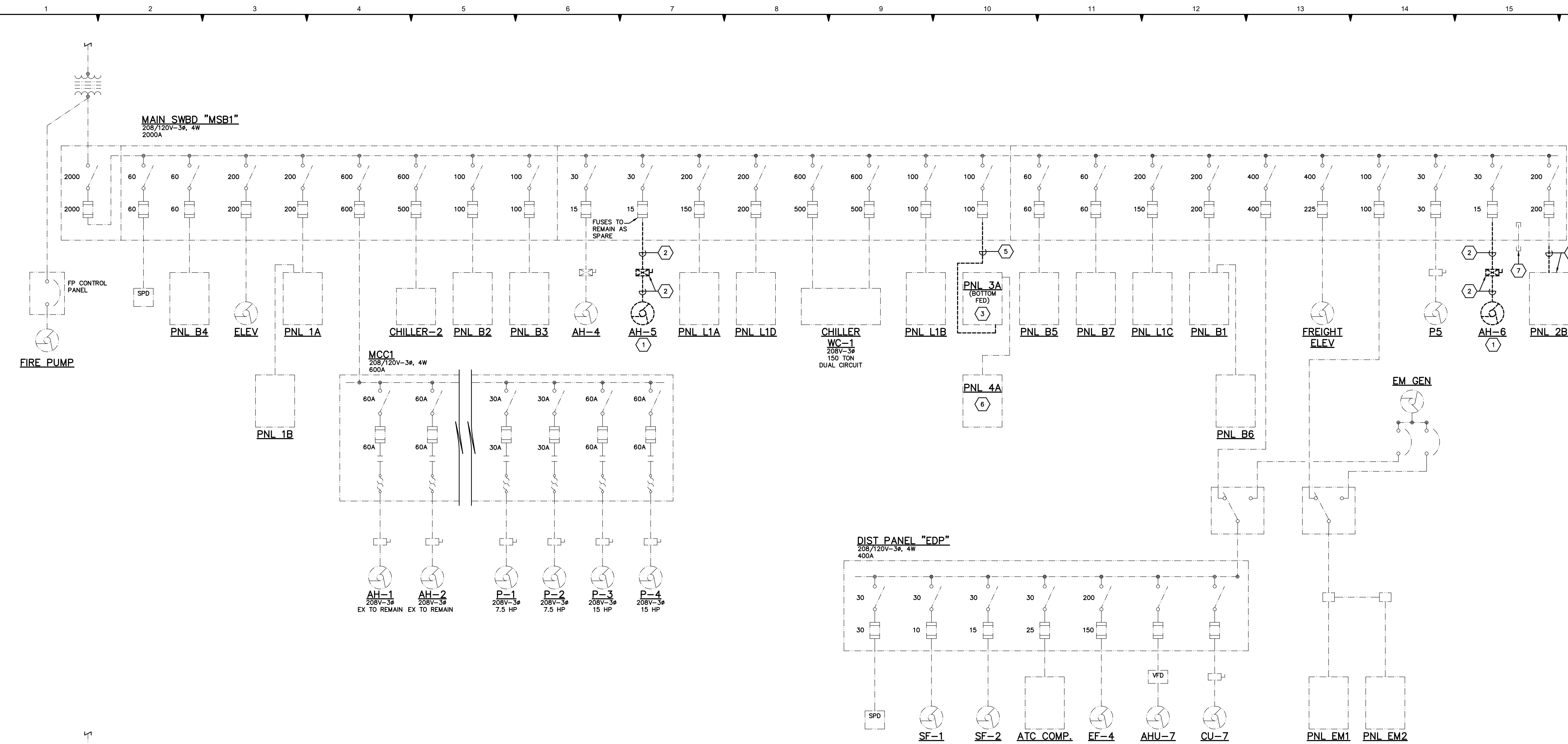
**E4**

**GENERAL NOTES**

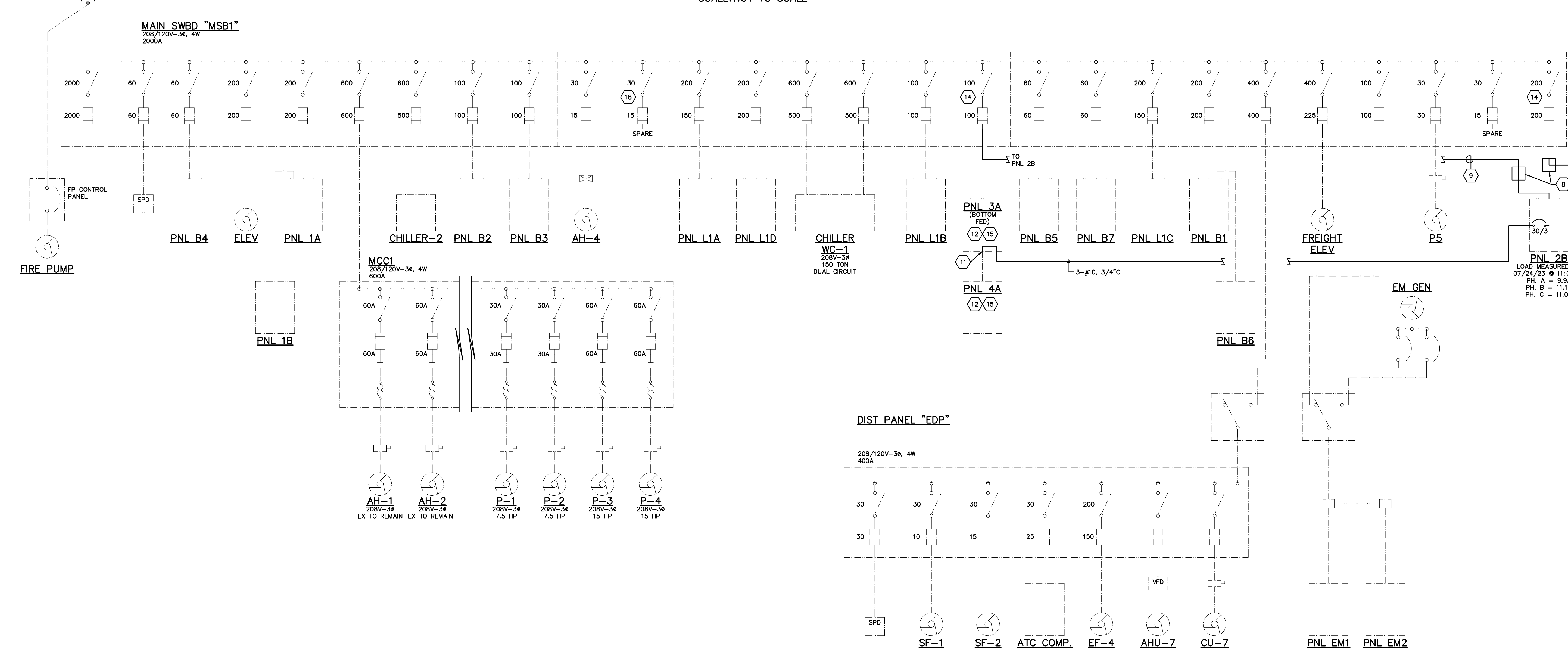
- A. ALL EQUIPMENT SHOWN IS EXISTING TO REMAIN UNLESS NOTED OTHERWISE.
- B. FUSE SIZES SHOWN ARE BASED ON EXISTING DRAWINGS WITHOUT FIELD VERIFICATION EXCEPT THOSE SERVING PANEL 2B, 3A AND 4A.

**CODED NOTES**

1. EXISTING EQUIPMENT TO BE REMOVED BY MECH CONTRACTOR.
2. EXISTING TO BE REMOVED. REMOVE ASSOCIATED CONDUIT AND WIRES BACK TO SOURCE UNLESS NOTED OTHERWISE ON FLOOR PLAN.
3. EXISTING PANEL TO BE RE-FED FROM NEW SOURCE. DISCONNECT AND REMOVE EXISTING FEEDER (CONDUIT IS USED AS EQUIPMENT GROUNDING CONDUCTOR) FROM MSB. FEEDER IS SPLICED WITH THAT OF PANEL 4A IN PANEL 3A. SEE NEW WORK PLAN ON THIS SHEET AND RESPECTIVE FLOOR PLANS FOR MORE INFO.
4. EXISTING PANEL TO REMAIN. FEEDER TO BE INTERCEPTED IN MECH ROOM ON SECOND FLOOR. SEE THIS SHEET AND SHEET E2 FOR MORE INFO. ALL EXISTING BRANCH CIRCUITS TO REMAIN.
5. DISCONNECT AND REMOVE EXISTING FEEDER BACK TO SOURCE. REMOVE ASSOCIATED EXPOSED CONDUIT. REMOVE ALL ASSOCIATED CONDUITS THAT ARE ACCESSIBLE ON ALL FLOORS.
6. EXISTING PANEL TO REMAIN. NO CHANGE TO FEEDER AND BRANCH CIRCUITS.
7. EXISTING 2" SPARE CONDUIT FROM MSB TO MECH ROOM ON SECOND FLOOR TO BE USED FOR NEW 100A FEEDER.
8. PROVIDE SPLICE/PULL BOX IN MECH ROOM AND HALLWAY ON SECOND FLOOR. SEE SHEET E2 FOR MORE INFO.
9. RUN 4-#2+#8 GRD IN EXISTING 2" CONDUIT FROM MSB TO RM 206, AND NEW 1-1/4" OR 2" CONDUIT FROM PULL BOX TO PANEL 2B.
10. SPLICE EXISTING FEEDER (4-3/0+#6) WITH NEW IN SPLICE BOX AND EXTEND TO NEW PANEL 3B IN 2" C.
11. SPLICE NEW FEEDER WITH EXISTING FEEDER FOR PANEL 4A. USE NEW CONDUIT AS EQUIPMENT GROUNDING CONDUCTOR FOR PANEL 3A.
12. THIRD AND FOURTH FLOORS ARE NOT CURRENTLY OCCUPIED AND WILL REMAIN AS UNOCCUPIED SPACE IN THIS PROJECT. ALTHOUGH RECEPTACLES AND LIGHTING CIRCUITS ON THESE FLOORS ARE CONNECTED TO PANEL 3A AND 4A RESPECTIVELY, ONLY LIGHTING CIRCUITS ARE USED FOR MINIMAL LIGHTING ON EACH FLOOR. HENCE, 30A/3P CIRCUIT IS SUFFICIENT FOR PANEL 3A AND 4A. THESE PANELS WILL BE REPLACED IN THE FUTURE RENOVATION PROJECT.
13. REPLACE EXISTING LABEL ON PANEL WITH PERMANENT ENGRAVED PLASTIC LABEL TO INDICATE THAT PANEL IS FED FROM 100A FUSES IN MSB1.
14. REPLACE EXISTING LABEL ON DISC SWITCH WITH NEW PERMANENT ENGRAVED PLASTIC LABEL, INDICATING NEW LOAD IT SERVES AND/OR SPARE.
15. REPLACE EXISTING LABEL ON PANEL WITH PERMANENT ENGRAVED PLASTIC LABEL TO INDICATE THAT PANEL IS FED FROM 30A BREAKER IN PANEL 2B.



**ONE LINE DIAGRAM - DEMOLITION**  
 SCALE: NOT TO SCALE



**ONE LINE DIAGRAM - NEW WORK**  
 SCALE: NOT TO SCALE

PROFESSIONAL SEAL  
  
 DOUGLAS L. POWELL  
 E-57325  
 9/9/24

ISSUE DATES		
NO.	DATE	DESCRIPTION
1	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
**OHIO MUSEUM COMPLEX  
 OU LIN HALL HVAC  
 100 RIDGES CIR.  
 ATHENS, OHIO 45701**

PROJECT NUMBER: 23002  
 DATE: 10/31/23  
 DRAWN:

SHEET TITLE  
**ONE LINE DIAGRAM**

SHEET  
**E5**

E4-23069  
**PRATER**  
 Engineering Associates, Inc.  
 6130 Wilcox Road (614) 766 4896  
 Dublin, Ohio 43016 praterengineering.com  
 DESIGNED BY: C. TONG    DRAWN BY: DJP    CHECKED BY: JOE NIA    JOB NO: 23069

## STARTER SCHEDULE

KEY: COMB - COMBINATION MAGNETIC ACROSS THE LINE; SB - STAR DELTA; MAM - MANUAL MAGNETIC ACROSS THE LINE; W - WALL MOUNTED; R - CEILING RECESSED; A - AUTO TRANSFORMER; C.T. - CONTROL TRANSFORMER; H.O.A. - HAND/OFF/AUTO SELECTOR SWITCH; P - PILOT LIGHT; S.S. - START/STOP PUSHBUTTONS; ON-OFF - ON/OFF MAINTAINED CONTACT SELECTOR SWITCH; H.A. - HAND AUTO SELECTOR SWITCH

EQUIPMENT ITEM	MOTOR HP	POWER VOLT	PHASE	TYPE	NEMA SIZE	AUX. N.O.	CONT. N.C.	DEVICES IN COVER	120 V. C.T.	MOUNTING LOCATION	REMARKS
RAF-5, RAF-6	2.0	208	3	COMB	0	2	2	H.O.A. PILOT LIGHT	YES	WALL MOUNT COORDINATE IN FIELD	-

## LIGHTING FIXTURE SCHEDULE

NOTE: FIXTURE NUMBER, LETTER PREFIX INDICATES TYPE OF MOUNTING AS FOLLOWS: CL - CEILING MOUNTED; S - STEM SUSPENDED; W - WALL MOUNTED; R - CEILING RECESSED; W - WALL RECESSED; CO - CEILING MOUNTED; UC - UNDER CABINET; RW - ROOF MOUNTED; SL - SITE LIGHT; GR - GROUND; CH - CHAIN SUSPENDED; P - PENDANT

FIXTURE NUMBER	DESCRIPTION	MANUFACTURER	CATALOG NUMBER	LAMPS	REMARKS
SI	4' LED STRIPLIGHT SEMI FROST LENS	COOPER DAYBRITE LS1	45NLED-LD5-53SL-LN-UV-LB40-CD	41W LED 5300 LUMENS 4000K	CHAIN HUNG MOUNT AT 10' A.F.F. COORDINATE WITH HVAC DUCTWORK
EX	LED EXT UNIVERSAL MOUNTED RED LETTERING AC ONLY	SURE-LITES CHLORIDE DAYBRITE	LPX6	1.2W LED	PENDANT MOUNT AT 8' A.F.F. WALL MOUNT AT 11'-0" ABOVE DOOR

ADDITIONAL SPECIFICATIONS: EQUIVALENT FIXTURES, BY THE FOLLOWING MANUFACTURERS, MAY BE FURNISHED AT THE CONTRACTOR'S OPTION: HUBBELL LIGHTING, PHILLIPS LIGHTING, ACUTY BRANDS, GE CURRENT, H.E. WILLIAMS, NORA, LITON OR ABB LIGHTING.

## ELECTRICAL ABBREVIATIONS

AWG	AMERICAN WIRE GAUGE	FIX	FIXTURE
A	AMPERE	G.C.	GENERAL CONTRACTOR
AF	ABOVE FINISHED FLOOR	GRD	GROUND
AFG	ABOVE FINISHED GRADE	LTG	LIGHTING
BFC	BELOW FINISHED GRADE	MPFR	MANUFACTURER
CLG	CEILING	MECH	MECHANICAL
ORC	CIRCUIT	PHL	PANEL
C	CONDUIT	RECEPT	RECEPTACLE
CONN	CONNECTION / CONNECTOR	REQ'D	REQUIRED
CONTR	CONTRACTOR	SW	SWITCH
CONT	CONTROL	TEMP	TEMPERATURE CONTROL PANEL
COORD	COORDINATE	TELE	TELEPHONE
DISC	DETAIL	TMR	TRANSFORMER
DISCONNECT	TYP	U.O.N.	UNLESS OTHERWISE NOTED
E.C.	ELECTRICAL CONTRACTOR	W.P.	WEATHERPROOF
E	EXISTING TO REMAIN		
FOR	FEEDER		

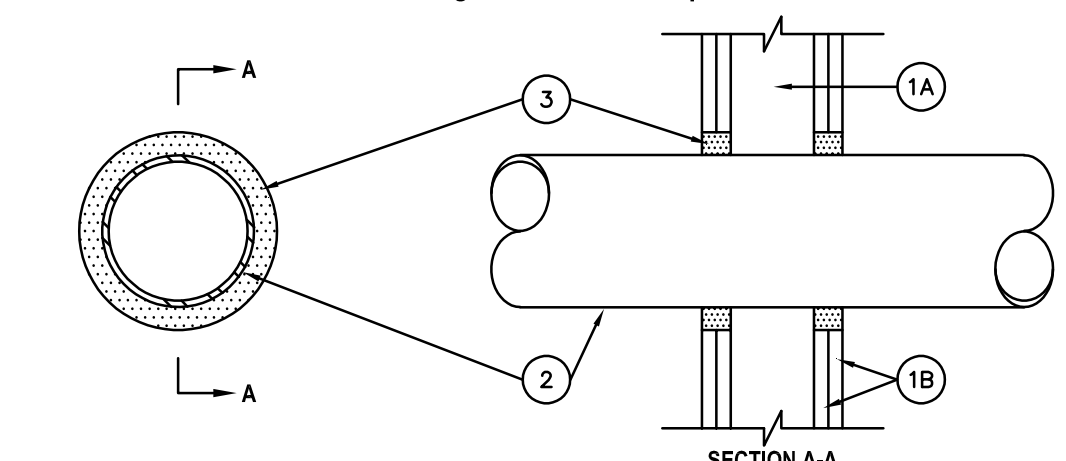
## ELECTRICAL LEGEND

SYMBOL	DESCRIPTION	MOUNTING HGT. TO CENTER UNLESS OTHERWISE NOTED
	RECESSED OR SUSPENDED LUMINAIRE/LIGHT FIXTURE REFER TO THE LIGHTING FIXTURE SCHEDULE	SEE DRAWINGS
	POLE MTD. LIGHT FIXTURE	SEE DRAWINGS
	WALL MTD. LIGHT FIXTURE	SEE DRAWINGS
	WALL MTD. EXIT LIGHT	AB DOOR
	CEILING MOUNTED EXIT LIGHT W/ DIRECTIONAL ARROWS	-
	CEILING OR WALL MTD. EXIT-EM LIGHT COMBO UNIT	CLG / AB DOOR
	EMERGENCY REMOTE HEADS	CLG / AB DOOR
	EMERGENCY BATTERY UNIT	90"
	DUPLEX RECEPTACLE	18"
	POWER AND VOICE/DATA POKE THROUGH	FLOOR MTD.
	DUPLEX RECEPTACLE WEATHERPROOF / GROUND FAULT	18"
	DUPLEX RECEPTACLE W/ GROUND FAULT INTERRUPTER	18"
	220V RECEPTACLE	18"
	DOUBLE DUPLEX RECEPTACLE	FLOOR
	20A POWER ONLY FLOOR BOX	18"
	JUNCTION BOX: WALL / CEILING MOUNTED: FLOOR MOUNTED	SEE DRAWINGS
	PULL BOX	SEE DRAWINGS
	TOGGLE SWITCH - SINGLE, 3-WAY & 4-WAY	42"
	TOGGLE SWITCH - K = OPERATED, WP = WEATHERPROOF	42"
	WALL BOX FOR "VOICE/DATA" OUTLET, 1-PORT, 2-PORT WITH 1/2" TO ABOVE CEILING OR TO 8' A.F.F. WHEN CONDUIT IS SURFACE MOUNTED, UNLESS A LARGER CONDUIT IS INDICATED	18"
	WALL TELEPHONE OUTLET	48"
	WIRELESS ACCESS POINT	CEILING
	MOTOR - 1 PHASE	AS REQUIRED
	MOTOR - 3 PHASE	AS REQUIRED
	MOTORIZED DAMPER - 1 PHASE	AS REQUIRED
	ELECTRICAL PANEL - SURFACE MOUNT, FLUSH MOUNT	6'-0" TO TOP
	PLYWOOD TELEPHONE BACKBOARD	SEE DRAWINGS
	SAFETY SWITCH	AS REQUIRED
	MAGNETIC MOTOR STARTER	AS REQUIRED
	COMBINATION MOTOR STARTER	AS REQUIRED
	MANUAL MOTOR STARTING SWITCH W/ PILOT LIGHT	42"
	MANUAL MOTOR CONTROLLER/DISCONNECT	42"
	LINE VOLTAGE THERMOSTAT	60"
	FIRE ALARM MANUAL PULL STATION	42"
	FIRE ALARM SIGNAL - AUDIO VISUAL	80"
	FIRE ALARM SIGNAL - STROBE ONLY	CEILING
	SMOKE DETECTOR - DUCT MOUNTED	SEE DRAWINGS
	SMOKE DETECTOR - CEILING	SEE DRAWINGS
	HEAT DETECTOR - CEILING	SEE DRAWINGS
	DUCT SMOKE DETECTOR W/ SMOKE DAMPER	SEE DRAWINGS
	SPRINKLER SYSTEM TAMPER SWITCH	SEE DRAWINGS
	SPRINKLER SYSTEM FLOW SWITCH	SEE DRAWINGS
	DUCT SMOKE DETECTOR REMOTE TEST SWITCH	SEE DRAWINGS
	FIRE ALARM BELL	SEE DRAWINGS
	DRY PIPE ALARM SWITCH	SEE DRAWINGS
	DRY PIPE LOW AIR PRESSURE SWITCH	SEE DRAWINGS
	VALVE SUPERVISORY SWITCH	SEE DRAWINGS
	PUSH BUTTON	SEE DRAWINGS
	GROUND BAR	18"
	FIRE ALARM TELEPHONE JACK	48"
	WIRED FURNITURE FEED JUNCTION BOX - WALL	18" U.N.O.
	FURNITURE FEED VOICE/DATA CONNECTION - WALL	18" U.N.O.
	DOOR AUTO OPERATOR PUSH PAD	42"
	DOOR HARDWARE AUTO OPERATOR	AB DOOR
	ELECTRIC POWER TRANSFER	AS REQUIRED
	ACCESS CONTROL CARD READER	46"
	CONTACT SWITCH	TOP DOOR FRAME
	ELECTRIC STRIKE/LOCK	AS REQUIRED
	ELECTRIC HINGE	AS REQUIRED
	MAGNETIC LOCK	AS REQUIRED
	DOOR HARDWARE POWER SUPPLY	AS REQUIRED
	PANIC HARDWARE	AS REQUIRED
	ACCESS CONTROL SAFE CONTACT SWITCH	AT EQUIPMENT
	FLUSH WALL BOX FOR "OCCTY" UNLESS NOTED OTHERWISE (WITH 3/4" C. TO HEADEND EQUIPMENT)	SEE DRAWINGS
	POWER METER	SEE DRAWINGS

## FIRE STOPPING DETAILS

### RATED WALLS

**METAL PIPE THROUGH GYPSUM WALL ASSEMBLY**  
System No. W-1054  
F Rating - 1 and 2 Hr (See Items 1 and 3)  
R Rating - 0 Hr  
L Rating at Ambient - Less than 1 CFM/Sq Ft  
L Rating at 400°F - 4 CFM/Sq Ft



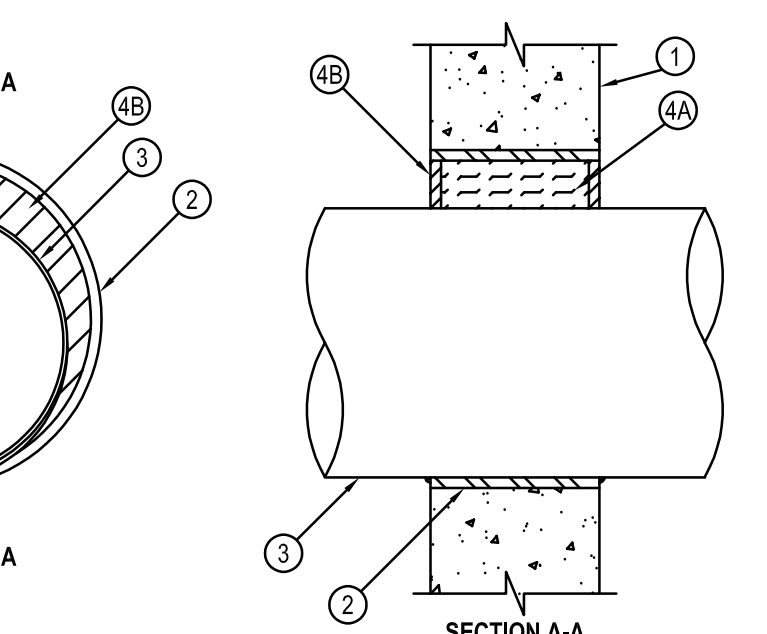
1. Wall Assembly - The 1 or 2 hr fire-rated gypsum wallboard/steel wall assembly shall be constructed of the materials and in the manner specified in the individual U500 or U400 Series Wall and Partition Designs in the UL Fire Resistance Directory and shall include the following construction features:  
A. Stud - Wall framing may consist of other wood studs or steel channel studs. Wood studs to consist of nominal 2x4 lumber spaced 16 in. O.C. Steel studs to be min 2-1/2 in. wide and spaced max 24 in. O.C. When steel studs are used and the span of opening exceeds the width of stud cavity, the opening shall be framed on all sides using lengths of steel stud installed between the vertical studs and secured to the steel studs at each end. The framed opening in the wall shall be 4 to 6 in. wider and 4 to 6 in. higher than the diam of the penetrating item such that, when the penetrating item is installed in the opening, a 2 to 3 in. clearance is present between the penetrating item and the framing on all four sides.  
B. Gypsum Board - 5/8 in. thick, 4 1/2 wide with square or tapered edges. The gypsum board type, thickness, number of layers, fastener type and sheet orientation shall be as specified in the individual U500 or U400 Series Designs in the UL Fire Resistance Directory. Max diam of opening is 32-1/4 in. for steel stud walls. Max diam of opening is 14-1/2 in. for wood stud walls. The F Rating of the firestop system is equal to the fire rating of the wall assembly.  
2. Through-Penetrations - One metallic pipe, conduit or tubing to be installed either concentrically or eccentrically within the firestop system. The annular space shall be min 0.1 in. to max 2-1/4 in. Pipe may be installed with continuous point contact. Pipe, conduit or tubing may be installed at an angle not greater than 45 degrees from perpendicular. Pipe, conduit or tubing to be rigidly supported on both sides of wall assembly. The following types and sizes of metallic pipes, conduits or tubing may be used:  
A. Steel Pipe - Nom 3/4 in. diam (or smaller) Schedule 40 (or heavier) steel pipe.  
B. Iron Pipe - Nom 3/4 in. diam (or smaller) cast or ductile iron pipe.  
C. Conduit - Nom 4 in. diam (or smaller) sheet electrical metallic tubing or 6 in. diam steel conduit.  
D. Copper Tubing - Nom 3/4 in. diam (or smaller) Type L (or heavier) copper tubing.  
E. Copper Pipe - Nom 6 in. diam (or smaller) regular (or heavier) copper pipe.  
3. Fire Stop or Caulk Material - Sealant - Min 1/8 in. thickness of fill material applied within the annulus. Flush with both surfaces of wall. At the point or continuous contact locations between pipe and wall, a min 1/2 in. diam bore hole shall be drilled in the pipe wall between the contact surfaces of wall.  
HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC. - FS-Cone Sealant

"Bearing the UL Classification Mark"  
HILTI Firestop Systems  
Reproduced by HILTI, Inc. Courtesy of Underwriters Laboratories, Inc. December 4, 2002

### METAL PIPE THROUGH CMU WALL ASSEMBLY

System No. W-1193

ANSI/UL 1476 (ASTM E814)	CANULOC 8119
F Rating - 2 Hr	F Rating - 2 Hr
T Rating - 1 Hr	T Rating - 2 Hr
L Rating at Ambient - Less than 1 CFM/Sq Ft	FT Rating - 2 Hr
L Rating at 400°F - 4 CFM/Sq Ft	FT Rating - 0 Hr
	L Rating at Ambient - Less than 1 CFM/Sq Ft
	L Rating at 400°F - 4 CFM/Sq Ft



1. Wall Assembly - Min 6 in. (152 mm) thick reinforced lightweight or normal weight (130-150 pcf or 1800-2400 kg/m<sup>3</sup>) concrete. Wall may also be constructed of any UL Classified Concrete Blocks. Max diam of opening is 16 in. (406 mm). See Concrete Blocks (CAZ) category in the Fire Resistance Directory for names of manufacturers.  
2. Steel Sleeve - Nom 1/2 in. (12.7 mm) diam (or smaller) Schedule 40 (or lighter) steel sleeve. Sleeve shall be installed in the opening. Length of steel sleeve to be equal to the thickness of wall.  
3. Through-Penetrations - One metallic pipe, tubing or conduit to be installed concentrically or eccentrically within the firestop system. The annular space between the pipes and conduits and the edges of the opening shall be min 0.1 in. (0 mm, point contacts) to max 3/16 in. (98 mm). Through penetration to be rigidly supported on both sides of wall assembly. The following types and sizes of through penetrations may be used:  
A. Steel Pipe - Nom 1/2 in. (12.7 mm) diam (or smaller) Schedule 40 (or heavier) steel pipe.  
B. Iron Pipe - Nom 1/2 in. (12.7 mm) diam (or smaller) cast or ductile iron pipe.  
C. Copper Tubing - Nom 3/4 in. (19.0 mm) diam (or smaller) Type L (or heavier) copper tubing.  
D. Copper Pipe - Nom 6 in. (152 mm) diam (or smaller) regular (or heavier) copper pipe.  
E. Conduit - Nom 6 in. (152 mm) diam (or smaller) electrical metallic tubing (EMT) or rigid steel conduit.  
4. Firestop System - The firestop system shall consist of the following:  
A. Packing Material - Min 5 in. (127 mm) thickness of min 2 pcf (64 kg/m<sup>3</sup>) mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from both surfaces of wall to accommodate the required thickness of fill material.  
B. Fire Stop or Caulk Material - Sealant - Min 1/2 in. (12.7 mm) thickness of fill material applied within the annulus. Flush with both surfaces of wall. At the point or continuous contact locations between pipe and wall, a min 1/2 in. diam bore hole shall be drilled in the pipe wall between the contact surfaces of wall.  
HILTI CONSTRUCTION CHEMICALS, DIV OF HILTI INC. - FS-Cone Sealant or FS-ONE MAX Intumescent Sealant  
\* Indicates such products shall bear the UL or cUL Certification Mark for jurisdictions employing the UL or cUL Certification (such as Canada), respectively.

HILTI Firestop Systems

## OCCUPANCY SENSOR LEGEND

	LOW VOLTAGE CEILING MOUNTED SELF-ADJUSTING DUAL TECHNOLOGY VACANCY SENSOR WITH 360° FIELD OF VIEW, SET TO AUTO ON/OFF OFF. GREENGATE OAC-07-1000 OR APPROVED EQUAL.
	JUNCTION BOX MOUNTED POWER PACK (AS REQUIRED), 120/277 VOLT INPUT, 20A LOAD RATING, 24VAC, 150 mA OUTPUT OR COMPATIBLE WITH OCCUPANCY SENSOR. INSTALL ABOVE ACCESSIBLE CEILING. POWER PACKS MAY NOT SHOWN ON PLANS, PROVIDE AS REQUIRED.

NOTES:

- FIELD ADJUST SETTINGS.
- INSTALL PER MANUFACTURER'S WRITTEN INSTRUCTIONS.
- APPROVED EQUALS SHALL BE BY PHILIPS, WATT-STOPPER, ACUTY CONTROLS.
- CEILING AND/OR WALL MOUNTED VACANCY SENSORS, SENSOR SWITCHES/DIMMERS AND POWER PACKS SHALL BE COMPATIBLE WITH LIGHT FIXTURES.
- ALL SWITCH/DIMMER COVER PLATES SHALL BE WHITE.

ES-23069

## PRATER Engineering Associates, Inc.

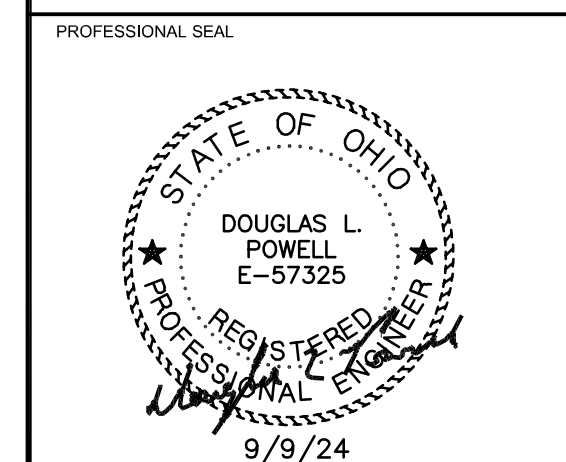
6130 Wilcox Road (614) 766 4896  
Dublin, Ohio 43016 praterengineering.com

DESIGNED BY	DRAWN BY	CHECKED BY	JOB NO.
C. TONG	DUJ	DUJ	23069



BDTAD, Inc.  
26 E. Park Drive, Athens, Ohio 45701  
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ONLINE: www.bdtad.com  
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ISSUE DATES

NO.	DATE	DESCRIPTION
9/9/24	9/9/24	ISSUED FOR RE-BIDDING

PROJECT TITLE  
OHIO MUSEUM COMPLEX  
OU LIN HALL HVAC  
100 RIDGES CIR.  
ATHENS, OHIO 45701

PROJECT NUMBER: 23002  
DATE: 10/31/23  
DRAWING

SHEET TITLE  
ELECTRICAL LEGEND  
ABBREVIATIONS  
SCHEDULES

SHEET  
E6

**SECTION 01 10 00**

**SUMMARY OF WORK**

**PART 1 - GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes:
  - 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Access to site.
  - 4. Attic Stock
  - 5. Work restrictions.
  - 6. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: Ohio Museum Complex HVAC Improvements
  - 1. Lin Hall  
Ohio University  
Athens, Ohio 45701.
- B. Owner: Athens County Commissioners, 15 S Court Street, Athens, Ohio 45701
  - 1. Owner Representative: Lenny Eliason, ph. 740-592-3219.
- C. Project Coordinator: Nathan Simons, HAPCAP, ph. 740-767-4500.
- D. Ohio University Representative: Nancy Stevens, [stevensn@ohio.edu](mailto:stevensn@ohio.edu), Jon Cozad, [cozadj1@ohio.edu](mailto:cozadj1@ohio.edu).
- E. Project Architect: Donald J Dispenza, BDT Architects & Designers, 26 East Park Drive, Athens, Ohio 45701, 740-592-2420.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
  - 1. Renovation and New Construction including site, architectural, electrical mechanical and HVAC systems
- B. Type of Contract
  - 1. Project will be constructed under single prime contract.

1.5 PHASING OF THE PROJECT

- A. No phasing is planned for the project:

1.6 ACCESS TO SITES

- A. General: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
1. Maintenance of Traffic/ Site Usage Plan: Contractor to prepare a MOT/ Site Usage plan indicating use of the site, planned crane set up locations, lay-down areas, fences, access, pedestrian protections, etc. and provide to A/E and City of Athens for review and approval and provide any and all revisions as required.
  2. Driveways and Entrances: Keep driveways, loading areas, and entrances serving adjacent premises clear and available to vehicles at all times. Do not use these areas for parking or storage of materials.
    - a. Schedule deliveries/ removals to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries/ removals to minimize space and time requirements for storage of materials and equipment on-site.

1.7 ATTIC STOCK

- A. Attic stock required by contract or available at the end of the project to be stored within the new building:

1.8 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
1. Comply with limitations of site, on use of public streets and University property and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: No limit. Evening work hours as requested by the contractor are to be coordinated with the County/ University.
1. Weekend Hours: As agreed to by the County/ University.
  2. Hours for Utility Shutdowns: As agreed to by the County/ University.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:
- D. Noise, Vibration, Dust and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, dust or other disruption.
1. Notify County not less than two days in advance of proposed disruptive operations.
  2. Comply with the City of Athens Noise Ordinance requirements.
- E. Nonsmoking Site: Smoking is not permitted on the site.



- F. Controlled Substances: Use of tobacco products and other controlled substances on the Project site is not permitted.

#### 1.9 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
  - 1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
  - 2. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
  - 1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
  - 2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and scheduled on Drawings.
  - 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

#### **PART 2 - EXECUTION (Not Used)**

**END OF SECTION**

SECTION 01 31 00

COORDINATION AND MEETINGS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coordination.
- B. Preconstruction meeting.
- C. Progress meetings.
- D. Examination.

1.2 COORDINATION

- A. Coordinate scheduling, submittals, and Work of the various sections of the Project Manual to assure efficient and orderly sequence of installation of interdependent construction elements.
- B. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- C. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- D. In finished areas conceal pipes, ducts, and wiring within the construction unless noted otherwise. Coordinate locations of fixtures and outlets with finish elements.
- E. Coordinate completion and clean up of Work of separate sections in preparation for Substantial Completion.
- F. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 PRECONSTRUCTION MEETING

- A. Architect will schedule a meeting prior to the start date to execute contract and coordinate schedule of work.
- B. Attendance Required: Owner, Architect and Contractor and selected sub contractors (fire suppression, plumbing, mechanical, electrical).
- C. Agenda:
  - 1. Submission of executed insurance certificates.
  - 2. Distribution of Contract Documents and Permit Documents.
  - 3. Designation of personnel representing the parties in Contract and the Architect.
  - 4. Review procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
  - 5. Scheduling of jobsite work hours.
  - 6. Parking and storage locations.
    - 7. Detailed work schedule and coordination.
    - 8. Submittals.

1.4 PROGRESS MEETINGS

- A. Meetings will be scheduled every two weeks after start of construction.

- B. Architect will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Attendance Required: Prime contractor's superintendents, sub-contractors, Owner, Architect, as appropriate to agenda topics for each meeting.
- D. Agenda:
  - 1. Review minutes of previous meeting.
  - 2. Review Work progress since previous meeting.
  - 3. Review of planned progress prior to next meeting.
  - 4. Review coordination of projected progress.
  - 5. Identify possible delays.
  - 6. Review status of submittals.
  - 7. Review progress schedule.
  - 8. Change order status and effect of changes on progress schedule.
  - 9. Old Business (field observation, problems, decisions, review quality).
  - 10. New Business.

PART 2 PRODUCTS  
No Requirements

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that existing site conditions are acceptable for subsequent Work. Beginning new Work means acceptance of existing conditions.
- B. Examine and verify specific conditions described in individual specification sections.
- C. Verify that utility services are available, of the correct characteristics, and in the correct location.

END OF SECTION

SECTION 01 32 33 - PHOTOGRAPHIC DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Predemolition photographs.

1.3 SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same label information as corresponding set of photographs.
- B. Construction Photographs: Submit digital of each photographic view within seven days of taking photographs.
  - 1. Digital Images: Submit a complete set of digital image electronic files as a Project Record Document on CD-ROM. Identify electronic media with date photographs were taken. Submit images that have same aspect ratio as the sensor, uncropped.

1.4 COORDINATION

- A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities, including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.

1.5 USAGE RIGHTS

- A. Obtain and transfer copyright usage rights from photographer to County for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in uncompressed TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1024 by 768 pixels.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage a qualified commercial photographer to take construction photographs.
- B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- C. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  - 1. Date and Time: Include date and time in filename for each image.
  - 2. Field Office Images: Maintain one set of images on CD-ROM in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of demolition, take color, digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag construction limits before taking construction photographs.
  - 2. Take photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take color, digital photographs daily with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
- F. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of color, digital photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.

END OF SECTION 013233

SECTION 01 33 00

SUBMITTALS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Submittal procedures.
- B. Shop drawings.
- C. Product data.
- D. Samples.
- E. Manufacturers' instructions.
- F. Manufacturers' certificates.

1.2 RELATED SECTIONS

- A. Section 01 77 00 - Contract Closeout.

1.3 SUBMITTAL PROCEDURES

1. Provide submittals for products requiring selection of color, pattern or texture.
2. Provide submittals for all equipment, fixtures and devices.
3. Provide submittals of items not specified by manufacturer/model number in the contract documents for review of quality.
4. Provide submittals of manufacturers installation requirements for all doors and hardware, windows, siding, roofing, cabinets, equipment, fixtures and devices .
5. Submit the number of copies which the Contractor requires, plus one copy which will be retained by the Architect/Engineer. If possible, submittals may be transmitted to the Architect by email, Don Dispenza, email: [dspender@bdtaid.com](mailto:dspender@bdtaid.com) . Email submittals reviews will be returned by email in pdf format with no hard copy returned.
6. Transmit each submittal with a transmittal form.
7. Identify Project, Contractor, Subcontractor or supplier; pertinent drawing and detail number, and specification section number, as appropriate. Provide space for Architect/Engineer review stamps.
8. Schedule submittals to expedite the Project, and deliver to Architect/Engineer. Coordinate submission of related items.
9. Identify variations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed Work.
10. When required to revise and resubmit, identify all changes made since previous submission.
11. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report any inability to comply with provisions.
12. Provide copies for record documents described in Section 017700 - CONTRACT CLOSEOUT.

#### 1.4 SHOP DRAWINGS

- A. Submit the number reproductions which Contractor requires, plus one copy which will be retained by Architect/Engineer, or email as noted above.
- B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

#### 1.5 PRODUCT DATA

- A. Submit the number of copies which the Contractor requires, plus one copy which will be retained by the Architect/Engineer, or email as noted above.
- B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.
- C. Indicate Product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

#### 1.6 SAMPLES

- A. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect/Engineer's selection.
- 2. Submit the number or samples specified in individual specification Sections; one of which will be retained by Architect/Engineer.

#### 1.7 MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer in quantities specified for Product Data.
- B. Identify conflicts between manufacturers' instructions and Contract Documents.

PART 2 PRODUCTS  
Not Used

PART 3 EXECUTION  
Not used

END OF SECTION

SECTION 01 45 00

QUALITY CONTROL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Quality assurance - control of installation.
- B. Tolerances
- C. References.

1.2 RELATED SECTIONS

- A. Section 01 33 00 - Submittals: Submission of manufacturers' instructions and certificates.
- B. Section 01 60 00 - Material and Equipment: Requirements for material and product quality.

1.3 QUALITY ASSURANCE - CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.
- B. Comply with manufacturers' instructions, including each step in sequence.
- C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.
- D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- E. Perform work by persons qualified to produce workmanship of specified quality.
- F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, or physical distortion.

1.4 TOLERANCES

- A. Monitor tolerance control of installed Products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust Products to appropriate dimensions; position before securing Products in place.



## 1.5 REFERENCES

- A. For Products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard by date of issue current on date of Contract Documents, except where a specific date is established by code.
- C. Obtain copies of standards where required by product specification sections.
- D. The contractual relationship, duties, and responsibilities of the parties in Contract nor those of the Architect shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

PART 2 PRODUCTS  
Not Used

PART 3 EXECUTION  
Not Used

END OF SECTION

## SECTION 01 73 29 - CUTTING AND PATCHING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.
- B. Related Sections include the following:
  - 1. Division 02 Section "Selective Demolition" for demolition of selected portions of the building.
  - 2. Divisions 02 through 49 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

#### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

#### 1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.
- C. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.
- D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.

### 3.3 PERFORMANCE

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

- B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  4. Proceed with patching after construction operations requiring cutting are complete.
- C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
    - c. Match parge finish and color of adjacent concrete along all cuts in concrete wall.
      - 1) Where cutting walls horizontally grind smooth to align with adjacent grade.
      - 2) Provide 2" chamfer at edges of cut concrete to match existing construction.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
- D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 73 29



01 77 00

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Closeout procedures.
- B. Final cleaning.
- C. Adjusting.
- D. Project record documents.
- E. Operation and maintenance data.
- F. Warranties.
- G. Spare parts and maintenance materials.

1.2 RELATED SECTIONS

- A. Section 01 50 00 - Construction Facilities and Temporary Controls: Progress cleaning.
- B. Section 01 66 00 - Starting of Systems: System start-up, testing, adjusting, and balancing.

1.3 CLOSEOUT PROCEDURES

- A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect's inspection.
- B. Provide submittals to Architect that are required by governing or other authorities.
- C. Submit final Application for Payment identifying total adjusted Contract Sum, previous payments, and sum remaining due.

1.4 ADJUSTING

- A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

- A. Maintain on site, one set of the following record documents; record actual revisions to the Work:
  - 1. Contract Drawings.
  - 2. Specifications.
  - 3. Addenda.
  - 4. Change Orders and other Modifications to the Contract.
  - 5. Reviewed shop drawings, product data, and samples.
- B. Store Record Documents separate from documents used for construction.
- C. Record information concurrent with construction progress.
- D. Specifications: Legibly mark and record at each Product section description of actual Products installed, including the following:
  - 1. Manufacturer's name and product model and number.

2. Product substitutions or alternates utilized.
  3. Changes made by Addenda and Modifications.
- E. Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to main floor datum.
  2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  3. Measured locations of utilities and appurtenances concealed in construction, referenced to visible/accessible features of the Work.
  4. Field changes of dimension and detail.
  5. Details not on original Contract Drawings.
- F. Submit documents to Architect with claim for final Application for Payment. Including lien waivers and affidavit noting contractor and all sub contractors have paid prevailing wage rates to all workers on the project.
- G. All door keys.
- H. "Site", State of Ohio permit drawings with sign off sheets completed.

#### 1.6 OPERATION AND MAINTENANCE DATA

- A. Submit two sets prior to final inspection, bound in 8-1/2 x 11 inch text pages binders with durable covers.
- B. Prepare binder covers with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project.
- C. Internally subdivide the binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.
- D. Contents: Prepare a Table of Contents for each volume, with each Product or system description identified.
- E. Part 1: Directory listing names, addresses, and telephone numbers of Architect, Contractor, Subcontractors, and major equipment suppliers.
- F. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
  1. Parts and equipment list.
  2. Operating instructions.
  3. Maintenance instructions for equipment and systems.
  4. Maintenance instructions for finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.
- G. Part 3: Project documents and certificates, including the following:
  1. Shop drawings and product data.
  2. Air and water balance reports, if required.
  3. Certificates.
  4. Warranties.
- H. Submit one copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned, with Architect comments. Revise content of documents as required prior to final submittal.
- J. Submit final volumes revised, within ten days after final inspection.

#### 1.7 WARRANTIES

- A. Provide notarized copies for project-specific warranties. Bind in manuals.
- B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.
- C. Submit prior to final Application for Payment.
- D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within ten days after acceptance, listing date of acceptance as start of warranty period.

#### 1.8 SPARE PARTS AND MAINTENANCE MATERIALS

- A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.
- B. Deliver to Project site and place in location as directed; obtain receipt prior to final payment.

#### PART 2 PRODUCTS

Not used

#### PART 3 EXECUTION

##### 3.1 FINAL CLEANING

- A. Execute final cleaning prior to final inspection:
  - 1. Clean interior and exterior glass and surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces.
  - 2. Clean equipment and fixtures to a sanitary condition.
  - 3. Clean debris from roofs, gutters, downspouts, and drainage systems.
  - 4. Clean site; sweep paved areas, rake clean landscaped surfaces.
- B. Remove waste and surplus materials, rubbish, and construction facilities from the site.

##### 3.1 FINAL INSPECTION

- A. Architect will schedule a final inspection of work upon notification from contractor that work has been completed.
- B. Contractor to inspect and correct work prior to final inspection:
  - 1. Verify any defects in finishes.
  - 2. Verify all equipment and fixtures are operating.
  - 3. Final cleaning.
  - 4. Final State inspections completed.

END OF SECTION





## SECTION 02 41 19 - SELECTIVE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:
  - 1. Demolition and removal of selected portions of building or structure.
  - 2. Salvage of existing items to be reused or recycled.
- B. Related Sections include the following:
  - 1. Division 01 Section "Summary" for use of premises and County-occupancy requirements.
  - 2. Division 01 Section "Temporary Facilities and Controls" for temporary construction and environmental-protection measures for selective demolition operations.
  - 3. Division 01 Section "Cutting and Patching" for cutting and patching procedures.

#### 1.3 DEFINITIONS

- A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.
- B. Remove and Salvage: Detach items from existing construction and deliver them to the County.

#### 1.4 QUALITY ASSURANCE

- 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 A10.6 and NFPA 241.

#### 1.5 PROJECT CONDITIONS

- A. County will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Universities operations will not be disrupted.
  - 1. Comply with requirements specified in Division 01 Section "Summary."

- B. Conditions existing at time of inspection for bidding purpose will be maintained by the County as far as practical.
- C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- D. Hazardous Materials: Hazardous materials are present in construction 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 material remediation is specified in Project Manual 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.
- 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.

## PART 2 - PRODUCTS (Not Used)

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped.
- B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.
  - 1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

- B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
1. County will arrange to shut off indicated services/systems when requested by Contractor.
  2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.
    - a. Where entire wall is to be removed, existing services/systems may be removed with removal of the wall.

### 3.3 PLUMBING SYSTEMS

- A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage
1. Comply with requirements for existing services/systems interruptions specified in Division 01 Section "Summary."

### 3.4 SELECTIVE DEMOLITION, GENERAL

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

1. Clean salvaged items.
2. Store items in a secure area until delivery to County.
3. Protect items from damage during transport and storage.

### 3.5 DISPOSAL OF DEMOLISHED MATERIALS

- A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Universities property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
1. Do not allow demolished materials to accumulate on-site.
  2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
  3. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- B. Burning: Do not burn demolished materials.
- C. Disposal: Transport demolished materials off County's property and legally dispose of them.

### 3.6 CLEANING

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

END OF SECTION 02 41 19

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
  - 1. Framing with dimensional lumber.
  - 2. Wood blocking and nailers.
- B. Related Sections include the following:
  - 1. Refer to structural plans for more information on framing members.

1.3 DEFINITIONS

- A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NLGA - National Lumber Grades Authority.
  - 2. SPIB - Southern Pine Inspection Bureau.
  - 3. WCLIB - West Coast Lumber Inspection Bureau.
  - 4. WWPA - Western Wood Products Association.

1.4 SUBMITTALS

- A. Product Data: none required.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS also see sheets S0.1 and S0.2 for additional structural wood notes.

- A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
  - 1. Factory mark each piece of lumber with grade stamp of grading agency.

2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.
5. Provide dry lumber with 15 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Wood Structural Panels:

1. Plywood: DOC PS 1, unless otherwise indicated.
2. Oriented Strand Board: DOC PS 2.
3. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
4. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
5. Factory mark panels according to indicated standard.

## 2.2 DIMENSION LUMBER

- A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.
- B. Joists, Rafters, and Other Framing Not Listed Above: Construction or No. 2 grade and any of the following species:
  1. Hem-fir; WCLIB or WWPA.
  2. Spruce-pine-fir; NLGA.

## 2.3 MISCELLANEOUS LUMBER

- A. General: Provide lumber for support or attachment of other construction, including the following:
  1. Blocking.
  2. Nailers.
- B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 15 percent maximum moisture content and the following species:
  1. Mixed southern pine; SPIB.
- C. For concealed boards, provide lumber with 15 percent maximum moisture content and the following species and grades:
  1. Mixed southern pine, No. 2 grade; SPIB.

## 2.4 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: CABO NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1..
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION, GENERAL

- A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- C. Use common wire 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; predrill as required.
- D. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

#### 3.2 WOOD BLOCKING, AND NAILER INSTALLATION



- A. See drawings for indicated blocking.
- B. Each trade to provide or coordinate with framer all required blocking.
- C. Blocking to be provided for cabinets, counters, wall hung items, wash room accessories, door wall stops and any other wall mounted door hardware.
- D. 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 involved.
- E. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

### 3.3 WOOD FRAMING INSTALLATION, GENERAL

- A. Framing Standard: Comply with AFPA's "Manual for Wood Frame Construction," unless otherwise indicated.
- B. Do not splice structural members between supports.
- C. Where patching areas of existing construction, use salvaged wood where possible. If not possible contact architect for discussion.

END OF SECTION 06100

## SECTION 072100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Glass-fiber blown-in: Attic

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 GLASS FIBER BLOW-IN INSULATION

- A. Glass Fiber Blown-In, with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E84; passing ASTM E136 for combustion characteristics.
  - 1. Owens Corning or equal

#### 2.2 ACCESSORIES

- A. Insulation for Miscellaneous Voids:
  - 1. Glass-Fiber Insulation: ASTM C764, Type II, loose fill; with maximum flame-spread and smoke-developed indexes of 5, per ASTM E84.
- B. Insulation Anchors, Spindles, and Standoffs: As recommended by manufacturer.
- C. Adhesive for Bonding Insulation: Product compatible with insulation and air and water barrier materials, and with demonstrated capability to bond insulation securely to substrates without damaging insulation and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

END OF SECTION 072100

## SECTION 072600 - VAPOR RETARDERS/ AIR BARRIER

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Polyethylene vapor retarders.

#### 1.2 ACTION SUBMITTALS

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

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.

### PART 2 - PRODUCTS

#### 2.1 POLYETHYLENE VAPOR RETARDERS

- A. Polyethylene Vapor Retarders: ASTM D4397, 6-mil- thick sheet, with maximum permeance rating of 0.1 perm.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF VAPOR RETARDERS ON FRAMING

- A. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.
- B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.
- C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.
- D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

- E. Seal around penetrations such as utilities and columns in order to create a monolithic, airtight membrane at grade surface, perimeter, and all vertical penetrations.

END OF SECTION 072600

## SECTION 074213 - FORMED METAL WALL PANELS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
  - 1. Exposed-fastener, lap-seam metal wall panels.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
- C. Samples: For each type of metal panel indicated.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Warranties: Samples of special warranties.

#### 1.4 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
  - 1. Finish Warranty Period: 10 years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E1592:

1. Wind Loads: As indicated on Drawings.
  2. Deflection Limits: For wind loads, no greater than 1/180 of the span.
- B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:
1. Test-Pressure Difference: 1.57 lbf/sq. ft..
- C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E331 at the following test-pressure difference:
1. Test-Pressure Difference: 2.86 lbf/sq. ft..
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

## 2.2 EXPOSED-FASTENER, LAP-SEAM METAL WALL PANELS

- A. Provide factory-formed metal panels designed to be field assembled by lapping side edges of adjacent panels and mechanically attaching panels to supports using exposed fasteners in side laps. Include accessories required for weathertight installation.
- B. Corrugated-Profile, Exposed-Fastener Metal Wall Panels Type 1 – Vertical, Type 2 – Horizontal,: Formed with alternating curved ribs spaced at 2.67 inches o.c. across width of panel. OR SIMILAR PER MANUFACTURERS STANDARD SHAPES
1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following or equal:
    - a. [CENTRIA Architectural Systems](#)
    - b. [Fabral](#).
    - c. [MBCI](#).
    - d. Alcoa Architectural Products
    - e. ATAS International
    - f. Berridge Manufacturing
    - g. McElroy Metal
    - h. OR EQUAL**
  2. At the contractor's option, provide either steel or aluminum wall panels per the following
  3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A653/A653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A755M.
    - a. Nominal Thickness: 0.022 inch.
    - b. Exterior Finish: Two-coat fluoropolymer.
    - c. Color: As selected by Architect from manufacturer's full range.

4. Aluminum Sheet: Coil-coated sheet, ASTM B209, alloy as standard with manufacturer, with temper as required to suit forming operations and structural performance required.
  - a. Thickness: 0.032 inch.
  - b. Surface: Smooth, flat finish.
  - c. Exterior Finish: Two-coat fluoropolymer.
  - d. Color: As selected by Architect from manufacturer's full range.
5. Rib Spacing: 2.67 inches o.c. – OR NEAREST MFG STANDARD SHAPE
6. Panel Coverage: As determined by contractor to fit layout .
7. Panel Height: 0.875 inch. – OR NEAREST MFG STANDARD SHAPE

### 2.3 MISCELLANEOUS MATERIALS

- A. Miscellaneous Metal Subframing and Furring: ASTM C645, cold-formed, metallic-coated steel sheet, ASTM A653/A653M, G90 coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.
- B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
  1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
  2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
  3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.
- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.
- E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
  1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing; 1/2 inch wide and 1/8 inch thick.
  2. Joint Sealant: ASTM C920; as recommended in writing by metal panel manufacturer.
  3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C1311.



## 2.4 FABRICATION

- A. Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
- C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

## 2.5 FINISHES

- A. Panels and Accessories:
  - 1. Two-Coat Fluoropolymer: AAMA 621 AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat
  - 2. Concealed Finish: White or light-colored acrylic or polyester backer finish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C754 and metal panel manufacturer's written recommendations.

### 3.2 INSTALLATION

- A. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
  - 1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
  - 2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
  - 3. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.

4. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
5. Flash and seal panels with weather closures at perimeter of all openings.

B. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch end lap, sealed with sealant and fastened together by interlocking clamping plates.

C. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

D. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

### 3.3 CLEANING

- A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

END OF SECTION 074213

## SECTION 076200 - SHEET METAL FLASHING AND TRIM

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section Includes:
1. Formed roof-drainage sheet metal fabrications.
  2. Formed steep-slope roof sheet metal fabrications.
  3. Formed wall sheet metal fabrications.

#### 1.2 ACTION SUBMITTALS

- A. Product Data: For each of the following
1. Underlayment materials.
  2. Elastomeric sealant.
  3. Butyl sealant.
  4. Epoxy seam sealer.
- B. Shop Drawings: For sheet metal flashing and trim.
1. Include plans, elevations, sections, and attachment details.
  2. Detail fabrication and installation layouts, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled Work.
  3. Include identification of material, thickness, weight, and finish for each item and location in Project.
  4. Include details for forming, including profiles, shapes, seams, and dimensions.
  5. Include details for joining, supporting, and securing, including layout and spacing of fasteners, cleats, clips, and other attachments. Include pattern of seams.
  6. Include details of termination points and assemblies.
  7. Include details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction from fixed points.
  8. Include details of roof-penetration flashing.
  9. Include details of edge conditions, including eaves, ridges, valleys, rakes, crickets, flashings, and counterflashings.
  10. Include details of special conditions.
  11. Include details of connections to adjoining work.
- C. Samples: For each exposed product and for each color and texture specified, 12 inches long by actual width.

#### 1.3 WARRANTY

- A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.
1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:

- a. Color fading more than 5 Delta E units when tested in accordance with ASTM D2244.
  - b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
  - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 20 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Sheet metal flashing and trim assemblies, including cleats, anchors, and fasteners, shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Sheet Metal Standard for Flashing and Trim: Comply with SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.
- C. Sheet Metal Standard for Copper: Comply with CDA's "Copper in Architecture Handbook." Conform to dimensions and profiles shown unless more stringent requirements are indicated.
- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
  1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

### 2.2 SHEET METALS

- A. Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.
- B. Steel sheet or Aluminum to match Wall/ Roof panels as selected by contractor.
- C. Aluminum Sheet: ASTM B209, alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required; with smooth, flat surface.
  1. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  2. Color: As selected by Architect from manufacturer's full range.
  3. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

- D. Metallic-Coated Steel Sheet: Provide; prepainted by coil-coating process to comply with ASTM A755/A755M.
1. Surface: Smooth, flat.
  2. Exposed Coil-Coated Finish:
    - a. Three-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent polyvinylidene fluoride (PVDF) resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
  3. Color: As selected by Architect from manufacturer's full range.
  4. Concealed Finish: Pretreat with manufacturer's standard white or light-colored acrylic or polyester backer finish, consisting of prime coat and wash coat with minimum total dry film thickness of 0.5 mil.

### 2.3 MISCELLANEOUS MATERIALS

- A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
    - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
    - b. Blind Fasteners: High-strength aluminum or stainless steel rivets suitable for metal being fastened.
    - c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.
  2. Fasteners for Aluminum Sheet: Aluminum or Series 300 stainless steel.
  3. Fasteners for Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel in accordance with ASTM A153/A153M or ASTM F2329.
- C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- D. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- E. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- G. Bituminous Coating: Cold-applied asphalt emulsion in accordance with ASTM D1187/D1187M.

- H. Asphalt Roofing Cement: ASTM D4586, asbestos free, of consistency required for application.

## 2.4 FABRICATION, GENERAL

- A. Custom fabricate sheet metal flashing and trim to comply with details indicated and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required.
  - 1. Fabricate sheet metal flashing and trim in shop to greatest extent possible.
  - 2. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
  - 3. Verify shapes and dimensions of surfaces to be covered and obtain field measurements for accurate fit before shop fabrication.
  - 4. Form sheet metal flashing and trim to fit substrates without excessive oil-canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
  - 5. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.
- B. Fabrication Tolerances:
  - 1. Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.
  - 2. Fabricate sheet metal flashing and trim that is capable of installation to tolerances specified.
- C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.
  - 1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
  - 2. Use lapped expansion joints only where indicated on Drawings.
- D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal in accordance with cited sheet metal standard to provide for proper installation of elastomeric sealant.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams:
  - 1. Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.
  - 2. Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
  - 3. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints where necessary for strength.

## 2.5 ROOF-DRAINAGE SHEET METAL FABRICATIONS

### A. Hanging Gutters:

1. Fabricate to cross section required, complete with end pieces, outlet tubes, and other accessories as required.
2. Fabricate in minimum 96-inch-long sections.
3. Furnish flat-stock gutter brackets and flat-stock gutter spacers and straps fabricated from same metal as gutters, of size recommended by cited sheet metal standard, but with thickness not less than twice the gutter thickness.
4. Fabricate expansion joints, expansion-joint covers, and gutter accessories from same metal as gutters.
5. Accessories: Wire-ball downspout strainer.
6. Gutters with Girth up to 15 Inches: Fabricate from the following materials:
  - a. Aluminum: 0.032 inch thick.
  - b. Steel: 0.022 inch thick.

### B. Downspouts: Fabricate rectangular downspouts to dimensions indicated on Drawings, complete with mitered elbows. Furnish with metal hangers from same material as downspouts and anchors.

1. Fabricate from the following materials:
  - a. Aluminum: 0.024 inch thick.
  - b. Steel: 0.022 inch thick.

## 2.6 STEEP-SLOPE ROOF SHEET METAL FABRICATIONS

### A. Drip Edges: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Steel: 0.022 inch thick.

### B. Eave, Rake Flashing: Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Steel: 0.022 inch thick.

## 2.7 WALL SHEET METAL FABRICATIONS

### A. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch-high, end dams. Fabricate from the following materials:

1. Aluminum: 0.032 inch thick.
2. Steel: 0.022 inch thick.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF UNDERLAYMENT

#### A. Felt Underlayment: Install felt underlayment, wrinkle free, using adhesive to minimize use of mechanical fasteners under sheet metal flashing and trim.

1. Install in shingle fashion to shed water.
2. Lap joints not less than 2 inches.

- B. Synthetic Underlayment: Install synthetic underlayment, wrinkle free, in accordance with manufacturers' written instructions, and using adhesive where possible to minimize use of mechanical fasteners under sheet metal.
  - 1. Lap horizontal joints not less than 4 inches.
  - 2. Lap end joints not less than 12 inches.

### 3.2 INSTALLATION, GENERAL

- A. Install sheet metal flashing and trim to comply with details indicated and recommendations of cited sheet metal standard that apply to installation characteristics required unless otherwise indicated on Drawings.
  - 1. Install fasteners, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
  - 2. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of sealant.
  - 3. Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement.
  - 4. Install sheet metal flashing and trim to fit substrates and to result in watertight performance.
  - 5. Install continuous cleats with fasteners spaced not more than 12 inches o.c.
  - 6. Space individual cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
  - 7. Install exposed sheet metal flashing and trim with limited oil-canning, and free of buckling and tool marks.
  - 8. Do not field cut sheet metal flashing and trim by torch.
- B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim.
  - 1. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.
  - 2. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
  - 3. Use lapped expansion joints only where indicated on Drawings.
- D. Fasteners: Use fastener sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.
- F. Seal joints as required for watertight construction.
  - 1. Use sealant-filled joints unless otherwise indicated.
    - a. Embed hooked flanges of joint members not less than 1 inch into sealant.
    - b. Form joints to completely conceal sealant.



- c. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way.
- d. Adjust setting proportionately for installation at higher ambient temperatures.

- 1) Do not install sealant-type joints at temperatures below 40 deg F.

- 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

### 3.3 INSTALLATION OF ROOF-DRAINAGE SYSTEM

- A. Install sheet metal roof-drainage items to produce complete roof-drainage system in accordance with cited sheet metal standard unless otherwise indicated. Coordinate installation of roof perimeter flashing with installation of roof-drainage system.

- B. Hanging Gutters:

- 1. Join sections with joints sealed with sealant.
- 2. Provide for thermal expansion.
- 3. Attach gutters at eave or fascia to firmly anchor them in position.
- 4. Provide end closures and seal watertight with sealant.
- 5. Slope to downspouts.
- 6. Install gutter with expansion joints at locations indicated on Drawings, but not exceeding, 50 feet apart. Install expansion-joint caps.

- C. Downspouts:

- 1. Join sections with 1-1/2-inch telescoping joints.
- 2. Provide hangers with fasteners designed to hold downspouts securely to walls.
- 3. Locate hangers at top and bottom and at approximately 60 inches o.c.
- 4. Provide elbows at base of downspout to direct water away from building.
- 5. Connect downspouts to underground drainage system.

### 3.4 INSTALLATION OF ROOF FLASHINGS

- A. Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard.

- 1. Provide concealed fasteners where possible, and set units true to line, levels, and slopes.
- 2. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

- B. Roof Edge Flashing:

- 1. Install roof edge flashings in accordance with ANSI/SPRI/FM 4435/ES-1.
- 2. Anchor to resist uplift and outward forces in accordance with recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.
- 3. Anchor to resist uplift and outward forces in accordance with recommendations in FM Global Property Loss Prevention Data Sheet 1-49 for FM Approvals' listing for required windstorm classification.

- C. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

### 3.5 INSTALLATION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet on slope and location lines indicated on Drawings and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

### 3.6 CLEANING

- A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.

### 3.7 PROTECTION

- A. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions.
- B. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures, as determined by Architect.

END OF SECTION 076200

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## **SECTION 21 00 00 - FIRE SUPPRESSION – GENERAL**

### **PART 1 GENERAL**

#### 1.01 REFERENCES

- A. Sections 21 11 00 through 21 13 13 (as included), cover Fire Protection work specifically.
- B. Refer to Sections 21 00 00 through 21 06 00 (as included), for items of general nature which apply to this portion of work.
- C. Applicable construction codes, standards and guidelines for all Fire Protection Contract elements, including but not limited to the following:
  - 1. State of Ohio Building Code, including Fire Protection portions thereof.
  - 2. Local Fire Department.
  - 3. Local Fire Marshall's Office.
  - 5. NFPA pamphlet no. 13, INSTALLATION OF SPRINKLER SYSTEMS.
  - 6. NFPA pamphlet no. 14, INSTALLATION OF STANDPIPE AND HOSE SYSTEMS.
  - 7. NFPA pamphlet no. 70, NATIONAL ELECTRIC CODE.
  - 8. NFPA pamphlet no. 72, NATIONAL FIRE ALARM CODE.
  - 9. City of Athens Division of Water the water utility provider.
  - 9. American National Standards Institute (ANSI) standards for materials and construction.
  - 10. American Society of Mechanical Engineers (ASME) standards for materials and construction.
  - 11. American Society for Testing and Materials (ASTM) standards for materials, construction and testing.
  - 12. American Water Works Association (AWWA) standards for materials and construction.
  - 13. Underwriter's Laboratories (UL) standards for materials and construction.
  - 14. Factory Mutual (FM) standards for materials and construction.
  - 15. The manufacturer's installation guidelines and recommendations for individual items and/or systems indicated herein.
  - 16. The Owner's insurance underwriter's material and installation guidelines and/or standards.

1.02 SCOPE

- A. The Fire Protection Contractor shall furnish all labor, materials, tools, incidentals and details necessary to provide a complete system of Fire Protection work as herein specified, as shown on plans, and as indicated or required by work under separate contract included with complete project documentation. Coordinate installation and interface requirements with the appropriate contractors in advance.
- B. The Fire Protection Contractor is responsible for satisfactorily addressing all review and inspection authorities' requirements and directives in regard to methods of installation necessary for final approval.
- C. The edition of all applicable NFPA Pamphlet's as recognized and amended by the Building Code Inspection/Approval Authority shall be the minimum requirement for all materials and methods. Unless indicated otherwise, and as a quality standard only, all materials shall be listed by Underwriter's Laboratories, Inc., and Factory Mutual Laboratories as approved for fire protection installations, when such is available.
- D. Fire protection sprinkler installation to be as required to provide "fully sprinkled" protection/coverage for the entire structure.
- E. In brief, the Scope of the Work shall include, but is not limited to the following:
  - 1. Connection to new Fire Protection Water service at 5'-0" beyond perimeter of building at location shown on plans.
  - 2. Installation of sprinkler/standpipe water meter/backflow prevention.
  - 2. Automatic Sprinkler Systems throughout the new structure.
  - 3. Installation of a wet standpipe system throughout the structure per Ohio Building Code, Ohio Fire Code and NFPA - 14
  - 4. Alarm valves; flow, pressure and tamper switches; and other alarm initiating devices.
  - 5. Layout Drawings, including all required design calculations and flow tests.
  - 6. Installation of all fire systems shall meet the requirements of the Owners Insurance Underwriter.
- F. Wiring:
  - 1. Unless indicated otherwise, all internal operation wiring incidental to the fire protection system shall be the responsibility of the Fire Protection Contractor, except wiring indicated by the Electrical Contract Documentation shall be by the Electrical Contractor. Electrical contract work includes external power input wiring to Fire Protection contract items, and wiring for flow alarms, supervisory switches, and any other alarm initiating or supervisory devices to and from the central fire alarm panel provided in the Electrical Contract.
  - 2. All wiring (if any) in the Fire Protection contract, including low voltage, shall be installed in conduit. All wiring, conduit and installation shall be in accordance with the National Electrical and Fire Alarm Codes, and the requirements of Division 16, Electrical Specification.
  - 3. The Fire Protection Contractor shall coordinate with the Electrical Contractor as required for proper installation and operation of items wired by the Electrical Contractor. This includes providing the locations of all devices to be wired to the Electrical Contractor at

the first opportunity, and coordinating the voltage and any other electrical requirements for all devices.

- G. The Fire Protection Contractor shall not submit or bid the sprinkler system as a gridded type system.
- H. This Contractor to be licensed by the State of Ohio for installation and service of fire protection systems, including alarm, detection, control and extinguishing components as indicated herein.
- I. Failure on the part of the Fire Protection Contractor to fulfill the above requirements will not relieve him of the responsibility of executing all work necessary for a complete and approved installation without extra expense to the Owner.

#### 1.03 PERMITS AND FEES

- A. Unless directed otherwise by the General Conditions portion of project documentation, the Fire Protection Contractor shall apply for and pay any review, inspection, permit, license, testing and/or other service fees required by all review/inspection/approval authorities in connection with the work under this Contract.
- B. Unless directed otherwise by the General Conditions portion of project documentation, the Fire Protection Contractor shall apply for and pay any procurement, tap, capacity, metering, testing and/or other service fees required by the Water Service Utility Provider in connection with the work under this Contract. This shall include procurement, execution and return of any forms and/or applications required; and participation in an initial design/installation consultation with the provider if required.
- C. The Fire Protection Contractor shall include in his Bid the cost for flow test information and hydraulic calculations required for design and approvals. The flow test is to be arranged with the Water Authority, the Local Fire Department and the Owner's Insuring Agency in advance to allow observation and supervision.

#### 1.04 DESIGN

- A. The Contractor is required to read the Specifications covering all branches of the work and will be held responsible for coordination of his work with work performed under all other Contracts.
- B. Sprinkler systems shall be designed, sized hydraulically and installed according to NFPA Pamphlet No. 13, and the rules and regulations of all review, inspection and approval authorities (required for final approval). See Plans for specific design information, including zoning, flow and density, allowances and head spacing.
- C. If the Contractor has any questions concerning the Plans and Specifications, he is to feel free to contact the Engineer for clarification before Bids, and to fully understand the extent and responsibilities of his work.
- D. Unless indicated otherwise at specific areas and/or locations, location of all sprinkler heads shall be determined by the Fire Protection Contractor, as required for protection specified, and final approval.
- E. The Fire Protection Contractor is responsible for locating all sprinkler heads in one of the optional ceiling tile installation points as detailed on drawings for gridded lay-in ceilings.

- F. Location of sprinkler heads by the Fire Protection Contractor is subject to approval by the Architect in review of the "Preliminary" Plans Submittal specified herein. The Architect reserves the right to relocate heads during this review, providing sprinkler protection is not compromised, and no conflicts occur with NFPA or inspection/approval authorities requirements as a result of relocations.

#### 1.05 FIRE PROTECTION SUPPLEMENTAL INFORMATION

- A. Water Source and Supply:
  - 1. Connection to existing underground public utility water main by Site Contract at site location indicated on plans.
- B. Building Information:
  - 1. See Architectural Documentation for detailed building code, occupancy classification(s) and construction information.
  - 2. See complete Architectural documentation, including plans, elevations, sections and details for additional information affecting fire protection work.
- C. Contact the City of Athens Division of Water for any information regarding water Flow Test Information. Note that this information does not rescind the Fire Protection Contractor's requirement to arrange a new flow test as specified herein, unless existing test information is acceptable to the review/inspection/approval authorities for fire protection design.

#### 1.06 TESTING AND INSPECTION

- A. Testing:
  - 1. Sprinkler Installation: The testing of the sprinkler installation shall conform to the applicable provisions of NFPA Pamphlet No. 13.
  - 2. Underground Installation: The testing and flushing of the underground installation shall conform to the applicable provisions of NFPA Pamphlet No. 24.
  - 3. Upon completion, and prior to the acceptance of the installation, the Contractor shall furnish the Owner with four (4) copies of the certification required. Testing of all piping for the Fire Protection system is to be made in accordance with the National Fire Protection Association and in the presence of a representative of the Owner and Insurance Company. As a minimum, a copy of "Contractors Certificate of Materials and Tests" properly executed and verifying satisfactory tests shall be furnished to the Owner upon completion of the tests.
- B. Inspection: When all work has been completed, the Contractor shall conduct a preliminary but complete inspection and testing of the installation. The system, as a whole, and all component parts thereof, shall receive all inspections and tests necessary to assure that the materials, equipment, devices and all functional operations meet the requirements of this specification and standards referenced herein.



- C. The Architect shall be notified of all scheduled tests at least 48 hours in advance so that he may witness same. If the Contractor performs any test or adjustment without the Architect present or without properly notifying the Architect, the Contractor will be required to perform the test or adjustment a second time in the presence of the Architect.

#### 1.07 COORDINATION

- A. All work shall be done in a neat and workmanlike manner and this Contractor shall coordinate his work with all other Contractors on the project to ensure that his work does not interfere with the proper installation of work by other trades.

#### 1.08 FIRE PROTECTION PLANS AND CALCULATIONS

- A. Prepare plans and calculations for review and approval by the Architect, the Insuring Agency and the review/inspection/approval authorities. Documentation (including plans and calculations) to be as specified in NFPA Pamphlet No. 13.
- B. Submit four (4) sets of plans and calculations to the Architect for "Preliminary" review. The Fire Protection Contractor shall address all comments generated by this review to the satisfaction of the Architect, prior to submittal to the inspection/approval authorities.
- C. Submit three (3) sets of plans and calculations to the Insurer for "Preliminary" review. The Fire Protection Contractor shall address all comments generated by this review to the satisfaction of the insurer, prior to submittal to the inspection/approval authorities.
- D. After plans and calculations have been reviewed and approved for construction by the review/inspection/approval authorities, provide four (4) sets of the documentation with all required stamps and approvals to the Architect for "Final" review and record.
- E. If applicable, wiring diagrams for all items included in the fire protection system shall be submitted for review, along with equipment submittals, plans and calculations. This includes manufacturer's standard diagrams for pre-wired items/elements such as tamper and flow switches, as well as any custom configured items/elements such as detection/control panels.

#### 1.09 SUPERVISION

- A. This Contractor shall have in charge of the work, on the job as required, during construction, a competent superintendent experienced in the work installed under this Contract.

#### 1.10 GUARANTEE

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year after final payment is approved by the Architect/Engineer/Owner's Representative.

### **PART 2 PRODUCTS**

- 2.01 Where items are indicated herein to be listed/approved, the intent of this specification is that said item shall be listed by all applicable material/construction standards, and subject to final approval (including methods of installation) by all review/inspection/approval authorities.

- 2.02 Unless indicated otherwise, all Fire Protection Contract items (pipe, fittings, valves, specialties, fixtures, equipment, etc.) materials, construction, performance, testing and methods of installation to be as listed/approved by all applicable material/construction/installation standards for same, and be in accordance with the requirements of all review/inspection/approval authorities. This includes, but is not limited to, the standards and authorities referenced in this specification. In the absence of such standards and/or requirements, the item/element manufacturer's recommendations, as confirmed by the Fire Protection Contractor in advance, shall be followed.
- 2.03 All Fire Protection Contract items shall have the manufacturer's mark or name and the quality of the product or identification of same cast, embossed, stamped or indelibly marked on each item/element in accordance with the standards under which they are accepted and approved per applicable code(s).
- 2.04 Unless indicated otherwise, all Fire Protection piping shall be in accordance with the following standards in regard to materials, construction, dimensions/tolerances and methods of installation (as applicable), and shall be so listed. Final approval for use is subject of the requirements of the review and inspection authorities:
- A. Steel pipe, malleable and cast iron fittings and joining methods; per applicable ASTM/ANSI/ASME standards.
  - B. Ductile iron pipe, fittings and joining methods; per applicable ASTM/ANSI/ASME/AWWA standards. In addition, where combination fire protection and domestic water service is utilized, all elements shall be per applicable NSF standards.
  - C. Plastic pipe, fittings and joining methods; per applicable ASTM/ANSI/ASME/AWWA standards. In addition, where combination fire protection and domestic water service is utilized, all elements shall be per applicable NSF standards.

### **PART 3 EXECUTION**

- 3.01 Where standards, codes or guidelines are referenced herein and throughout the Fire Protection Contract documentation, including plans and specifications, the latest version/edition shall be applied, unless the Building Code references another version/edition, which shall take precedence.
- 3.02 Refer to project documentation furnished with the complete construction package in advance of work for overall coordination and verification of requirements at work of other trades relating to, interfacing with, and/or impacting work in the Fire Protection Contract. This includes exact locations, quantities, physical sizes, rough-in details, pipe routing, connection sizes, etc., for items included both in the Fire Protection Contract and under separate contract. Coordinate installation and interface requirements with the appropriate contractor(s) in advance of work.
- 3.03 Include any minor details, items essential to necessary approvals and successful operation in addition to the items specified herein and shown on plans.
- 3.04 See general "FIRE PROTECTION NOTES" on plans for additional conditions and requirements relative to the Fire Protection Contract.
- 3.05 Fire Protection items shall be installed with due regard to preservation of the strength of structural members and prevention of damage to walls, surfaces and other structures through installation, bearing support or subsequent usage of Fire Protection items and elements. No framing or other support structure shall be cut, notched or bored in excess of limitations specified in the Building Code, or by the manufacturer of the framing or other support structure, as confirmed in advance of work by the Fire Protection Contractor.

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CONSTRUCTION DOCUMENTS  
JANUARY 9, 2024  
OU PROJECT 23002

**END OF SECTION**

## SECTION 21 05 00 - FIRE SUPPRESSION GENERAL PROVISIONS

### PART 1 GENERAL

#### 1.01 GENERAL REQUIREMENTS

- A. Furnish all labor, materials, tools, incidentals and details necessary to provide a complete fire protection system, ready to operate, including but not limited to the items listed under the Fire Protection Indexes.
- B. Include any minor details essential to successful operation and any other items specified or shown on the Drawings.
- C. The Contractor is required to read the Specifications covering all branches of the work and will be held responsible for coordination of his work with work performed under all other Contracts.
- D. The Contractor is required to visit the site and fully inform himself concerning all conditions affecting the scope of his work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his Contract.
- E. The Contractor should feel free to contact the Architect immediately if there is any question regarding the meaning or intent of either Plans or Specifications, or if he notices any discrepancies or omissions in either Plans or Specifications.
- F. Other than minor adjustments shall be submitted to the Architect for approval before proceeding with the work.
- G. The Contractor shall submit on his letterhead, along with the Bid, the manufacturer's name and the names of all Subcontractors to whom he intends to sublet the work. If the Contractor fails to provide this information with the Bid, the owner shall have the right to select the manufacturers and Subcontractors with no additional charge.
- H. Scheduling of all work performed by this Contractor shall be completely coordinated with the Construction Manager.
- I. All material hoisting by trade involved.
- J. All connections to, or revisions in, piping layout or facilities shall be done at such time as agreed to by the Architect and the Owner and all work shall be scheduled as required under "General Conditions". Revisions to the existing piping systems must be done with the minimum of shutdown time. All piping shall be run to the point of new connections and new equipment installed and ready to operate before any connections are to be made.
- K. Extreme care shall be taken to avoid interference with equipment and work of other trades. Consult with the Construction Manager regarding any points where interference is likely to occur and follow dimensions carefully where given on the Drawings. Pay particular attention to minimum clear heights when indicated on the Drawings.
- L. It is mandatory that dust and debris be held to a minimum.

- M. The Contractor, insofar as this Contract is concerned, shall at all times keep the premises and the building in a neat and orderly condition. This includes using a vacuum cleaner in the office areas.
- N. At the completion of the project, this Contractor shall promptly clean up and remove from the site, all debris and excess materials.

#### 1.02 DRAWINGS

- A. Consult all Contract Drawings which may affect the locations of any equipment, apparatus, piping and ductwork and make minor adjustments in location to secure coordination.
- B. Piping and duct layout is schematic and exact locations shall be determined by structural and other conditions and verified in the field. This shall not be construed to mean that the design of the system may be changed, it refers only to the exact location of piping and ductwork to fit into the building as constructed, and to coordination of all work with piping and equipment included under other Divisions of the Specifications.
- C. The layout shown on the Drawings is based on a particular make of equipment. If another make of equipment is used which requires modifications or changes of any description from the Drawings or Specifications, this Contractor shall be responsible for making all such modifications and changes, including those involving other trades, as a part of this Contract and the cost thereof shall be included in his Bid. In such case, the Contractor shall submit Drawings and Specifications showing all such modifications and changes prior to starting work, which shall be subject to the approval of the Engineer.
- D. The Architect and Engineer reserves the right to make minor changes in the location of piping and equipment up to the time of rough-in without additional cost to the Owner.
- E. Where certain grades and/or elevations are given on the Drawings, they have been obtained from the best information available; however, they are not guaranteed. This Contractor MUST assume the full responsibility of verifying present elevations in the field and making any adjustments as may be necessary, all of which must be included in his Bid Price.
- F. Due to the scale of the Drawings, it is impossible to show all offsets and transitions which may be required. This Contractor shall carefully investigate the conditions affecting all work and shall furnish all elbows, fittings, transitions, etc., required to accomplish the desired result at no additional cost.
- G. Install all work as close as possible to walls, structural, members, etc., consistent with the proper space for covering, access, etc., so as to occupy the minimum of space and allow as much space as possible between ductwork, piping, etc. and the ceiling.
- H. Actual dimensions shown on the Drawings and field dimensions shall take precedence over scaled dimensions.

#### 1.03 PERMITS, INSPECTIONS AND CODES

- A. Completed installations shall conform with all applicable Federal, State and Local Laws, Codes and Ordinances, including but not limited to the latest editions of the following:
  - 1. Ohio Building Code, State of Ohio.

2. Ohio Pressure Piping Systems Code, State of Ohio.
  3. A.S.M.E. Pressure Piping Code - Section B31.1
  4. National Electrical Code, Bulletin No. 70, National Fire Protection Association.
  5. Life Safety Code, Bulletin No. 101, National Fire Protection Association.
- C. Nothing contained in the Plans and Specifications shall be construed to conflict with these laws, codes and ordinances and they are hereby made a part of these Specifications.

#### 1.04 OHIO ENERGY CODE

- A. The Mechanical System must comply with all requirements of the State of Ohio "Code for Energy Conservation". This includes, but is not limited to, efficiencies, power factors, insulation thickness, etc.
- B. All motors 1 HP or more shall be "energy efficient" motors meeting all requirements of ASHRAE Standard 90.1 - 1989 (and Addendum C dated 1993).

#### 1.05 UTILITIES

- A. The Contractor shall investigate and locate all utilities prior to construction.
- B. Each Contractor is responsible for rerouting or replacing existing utilities where necessary to permit installation of his work.
- C. Support, protection and restoration of all existing utilities and appurtenances shall be the responsibility of the Contractor. The cost of this work shall be included in the price bid for the various items.
- D. The Contractor shall alert immediately the occupants of nearby premises as to any emergency that he may create or discover on or near such premises of the underground facility, any break or leak on its lines or any dent, gouge, groove or other damage.

#### 1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. This Contractor shall thoroughly instruct and supervise the Owner's Maintenance Personnel in the proper operation and maintenance of the mechanical system equipment. This Contractor shall be responsible for arranging for the instruction and supervision at a time convenient to the Owner and notifying the Engineer of the time at least 48 hours in advance.

Instructions shall include the following:

1. Location of equipment and explanation of what it does.
2. Reference to "Operating Instruction Manuals" for record and clarity.
3. Coordination of written and verbal instruction so that each is understood by all personnel.

4. Specific maintenance to be performed by Owner.
- B. Furnish one (1) copy of the printed Operating and Maintenance Instructions for the Mechanical Systems for review. Copy shall be neat, legible and bound in a hardback 3-ring notebook. After final approval, provide four (4) copies of Operation and Maintenance Instructions for submittal to Owner. Instructions shall consist of the following items:
1. Title Page: Title of Project, address, date of submittal, name and address of Contractor, name of Engineer.
  2. Second Page: Index of Manual Contents.
  3. First Section: A copy of each approved shop drawing and submittal with an index at the beginning of the section.
  4. Second Section: A list of all equipment used on the project, together with supplier's name and address.
  5. Manufacturer's maintenance manuals for each item of equipment furnished under this contract. Manuals shall include such items as parts list, detailed lubrication instructions, procedures for performing normal maintenance functions, preliminary trouble shooting procedures and wiring diagrams.
  6. Complete wiring diagrams for the mechanical systems as actually wired including control and interlock wiring.
  7. Brief but complete instructions for start-up, shut- down and routine maintenance of each system.
  8. Routine and 24-hour emergency information:
    - a. Name, address and telephone number of servicing agency.
    - b. Include names of personnel to be contacted for service arrangements.
- C. Frame one (1) copy of brief start-up, shut-down and routine maintenance instructions and complete system wiring diagrams under glass and mount on the Equipment Room wall. Temperature Control schematics may be laminated with plastic at the Contractor's option.

#### 1.07 RECORD DOCUMENTS

- A. The Contractor shall keep an accurate record of all deviations from Contract Drawings and Specifications. He shall neatly and correctly enter in colored pencil any deviations on Drawings affected and shall keep the Drawings available for inspection. Extra sets of Drawings will be furnished for this purpose.
- B. At the completion of project and before final approval, make any final corrections to Drawings and certify to the accuracy of each print by signature and deliver same to the Architect.

1.08 SUPERVISION

- A. This Contractor shall have in charge of the work, on the job during construction, a competent superintendent experienced in the work installed under this Contract.

1.09 UNACCEPTABLE WORK AND OBSERVATION REPORTS

- A. Work shall be unacceptable when found to be defective or contrary to the Plans, Specifications, Codes specified or accepted standards of good workmanship.
- B. The Contractor shall promptly correct all work found unacceptable by the Engineer or the Owner whether observed before or after substantial completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such unacceptable work, including compensation for the Engineer's or Owner's additional services made necessary thereby.
- C. During the course of construction, the Engineer will prepare "Observation Reports" with a list of items found to be in need of correction. All items listed shall be corrected by the Contractor. A space is provided on the form for the Contractor to note the completion of each item. All prior "Observation Report" items must be completed, the lists signed and returned to the Engineer prior to making the final inspection. After the final list is issued, the same procedure will apply.

1.10 FINAL INSPECTION

- A. When the Contractor determines all work is completed and working properly per the Contract Documents, he shall request a "final" inspection by the Engineer in writing. If more than one reinspection is required after this final inspection, the Contractor shall bear all additional costs including compensation for the Engineer's additional services made necessary thereby. A final inspection will not be made until Operating and Maintenance Manuals and Air Balance Reports are submitted and approved and all prior "Observation Report" punch lists completed, signed and returned to the Engineer.
- B. As part of the final checkout of the project, the Engineer will be checking out the operation of the various systems. This Contractor shall provide such assistance as required (including manpower and tools) to start and stop the various systems, open and close valves etc. and simulate summer, winter and other temperature control sequences. The Contractor (not the Engineer) is responsible to turn on the systems and demonstrate they are operating properly.

1.11 GUARANTEE

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year after final payment is approved by Architect.

**PART 2 PRODUCTS**

Not Applicable.



**PART 3 EXECUTION**

Not Applicable.

**END OF SECTION**

## SECTION 21 05 05 - 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. Grout.
  - 6. Equipment installation requirements common to equipment sections.
  - 7. Painting and finishing.
  - 8. 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.
- F. 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. 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. 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 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. 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.

## 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."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### 2.2 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.
- D. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

#### 2.4 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel 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. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw, and chrome-plated finish.
- C. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.7 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 FIRE-SUPPRESSION DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

### 3.2 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.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.

- e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
  - f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- O. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
  - 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.
- P. 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.
- 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.

### 3.3 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.

E. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

F. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.4 PAINTING

A. Painting of fire-suppression systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.5 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor fire-suppression materials and equipment.

C. Field Welding: Comply with AWS D1.1.

### 3.6 GROUTING

A. Mix and install grout for fire-suppression 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 around anchors.

F. Cure placed grout.

**END OF SECTION**

## **SECTION 21 05 13 - ELECTRICAL WORK**

### **PART 1 GENERAL**

#### 1.01 REFERENCE

- A. Section 23 01 05 - Paragraph 1.05 - OHIO ENERGY CODE
- C. Division 26 - ELECTRICAL

#### 1.02 SCOPE

- A. This Contractor shall furnish all motors for his equipment. Motor starters, safety switches and wired junction boxes shall be furnished and installed by the Electrical Contractor except where specifically specified to be furnished with certain mechanical equipment.

#### 1.03 WORK INCLUDED - This Contractor:

- A. 120 volt wiring required for mechanical equipment when not shown or specified elsewhere.

#### 1.05 WORK INCLUDED - Electrical Contractor.

- A. All power wiring.

#### 1.06 SHOP DRAWINGS:

- A. The Contractor shall furnish to the Electrical Contractor, equipment shop drawings which will indicate power hook-up and control connections as required for mechanical equipment. "Stock" Wiring Diagrams are Not Acceptable.

### **PART 2 PRODUCTS**

2.01 Refer to Section 21 01 05 - Paragraph 1.05 for "Energy Code" requirements (Particularly power factor correction)

2.02 Refer to Division 16 - ELECTRICAL.

2.03 All single-phase motors provided by this Contractor to have built-in thermal overload protection.

2.04 All motors furnished shall have copper windings and all motors five (5) horsepower and greater shall have factory installed lifting eyebolts. All motors shall conform to ANSI and NEMA standards.

### **PART 3 EXECUTION**

3.01 All wiring, conduits, etc., shall be in strict accordance with the requirements of the latest edition of the National Electrical Code and Division 26, Electrical specification.

3.02 All wiring, including low voltage wiring, shall be run in conduit.

3.03 Low voltage wiring may be size and type recommended by the Manufacturer.

### **END OF SECTION**



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## **SECTION 21 05 16 - SLEEVES AND COLLARS**

### **PART 1 GENERAL**

#### 1.01 REFERENCE

- A. Section 21 05 21 - CUTTING AND PATCHING

#### 1.02 SCOPE

- A. This Contractor shall furnish and install all sleeves for his work. Coordinate carefully with the General Contractor.
- B. Sleeves shall be provided through all new masonry construction. Sleeves are not required if holes are core drilled through existing walls.

### **PART 2 PRODUCTS**

- 2.01 Sleeve material: Schedule 40 ASTM A-53 black steel pipe, machine cut, large enough to allow 1/4" clearance all around pipe (around pipe covering on chilled water and cold water).

### **PART 3 EXECUTION**

- 3.01 Sleeves in partitions to have length equal to the thickness of finished partitions. Sleeves in floors of finished areas to project 1/8" above finished floor. Sleeves in floors of non-finished areas to project 3" above finished floor. Fill space between pipe and sleeves into exposed areas with sealing compound. Ream all sleeves before installing.
- 3.02 Where pipes pass through fire rated walls or floors, the space between the pipe and sleeve shall be filled with packing to maintain fire integrity.
- 3.03 Sleeves to be set in forms before concrete is poured and in partitions at the time same are being built.
- 3.04 In exposed location, other than in Mechanical Equipment Rooms, bare pipe or insulated pipe shall be provided with chromium plated collars at floor, ceiling, and at partitions.
- 3.05 Cutting required of any masonry wall or floor after it is in place shall be done by core drilling.
- 3.06 Piping not allowed to bear on sleeves.
- 3.07 Sleeves shall be installed plumb and true to line, grade, and position.
- 3.08 Unused sleeves shall be plugged and finished to match adjacent surface.

### **END OF SECTION**

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## SECTION 21 05 17 - FIRESTOPPING

### PART 1 GENERAL

#### 1.01 SCOPE

- A. Each Contractor shall be responsible for firestopping around all openings for pipes, ducts, conduits, etc., installed by him at all fire walls and smoke walls. Firestopping shall be performed by an installer who has been trained by manufacturer, or manufacturer's representative, in the installation procedures based on published UL tested fire stop systems.

#### 1.02 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

#### 1.03 REFERENCE

- A. Division 1 – General Conditions
- B. Division 3 – Concrete
- C. Division 4 – Masonry
- D. Division 9 – Finishes
- E. Section 21 05 16 – Sleeves and Collars

#### 1.04 GENERAL REQUIREMENTS

- A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Through-Penetration Firestop Devices (XHCR)
    - b. Fire Resistance Ratings (BXUV)
    - c. Through-Penetration Firestop Systems (XHEZ)
    - d. Fill, Voids, or Cavity Material (XHHW)
    - e. Forming Materials (XHKU)
- C. International Firestop Council Guidelines for Evaluating Firestop Systems Associating Judgments
- D. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. The Ohio Building Code (OBC)
- F. NFPA 101 - Life Safety Code

#### 1.05 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Firestop System installation must meet requirements of ASTM E-814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

#### 1.06 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- C. Submit material safety data sheets provided with product delivered to job-site.

#### 1.07 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.

- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

1.09 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
  - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
  - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

**PART 2 PRODUCTS**

2.01 FIRESTOPPING, GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that is needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
  - 1. Hilti, Inc., Tulsa, Oklahoma, (800)879-8000
  - 2. Tremco Sealants & Coatings, Beachwood, Ohio, (216) 292-5000

3. 3M Fire Protection Products, St. Paul, Minnesota, (612) 736-0203

2.03 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:
1. Hilti CP 680 Cast-In Place Firestop Device
  2. Fox Coupling, Inc. "Cast-In-Place Firestop Coupling".
  3. Proset Cast-In-Place Device
- C. Sealant or caulking materials for use with non-combustible items including steel pipe & copper pipe, the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
  2. 3M Fire Barrier CP25 or Firestop Sealant 2000
  3. Tremco Fyre Shield
- D. Sealant or caulking materials for use with sheet metal ducts, the following products are acceptable:
1. Hilti CP 601S Elastomeric Firestop Sealant or CP 606 Flexible Firestop Sealant
  2. Tremco Fyre-Shield High Performance Ceramic Firestop Sealant
  3. 3M Fire Barrier CP25WB+ or 2000 Silicone Sealant
- E. Intumescent sealant or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe and plastic pipe, the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
  2. 3M Fire Barrier CP25WB+
  3. Tremco Intumescent Acrylic or TremStop WBM
- F. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
1. Hilti CP 642 and CP643 Firestop Collar, CP645 Wrap Strip
  2. Tremco TREMstop D Combustible Pipe Intumescent Device System and TremStop WS Wrap Strip
  3. 3M Ultra Plastic Pipe Device and Fire Barrier FS-195+ Wrap Strip
- G. Materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
1. Hilti FS 635 Trowelable Firestop Compound and FS 657 FIRE BLOCK
  2. Tremco TremStop M Fire Rated Mortar and PS Pillows
  3. 3M Fire Barrier CS-195+ Composite Sheet



- H. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
  - 1. Hilti FS 657 FIRE BLOCK
  - 2. Tremco PS Firestop Pillows
  - 3. 3M CS Intumescent Sheet
- I. Provide a firestop system with an "F" Rating as determined by UL 1479 or ASTM E814. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated.

### **PART 3 EXECUTION**

#### **3.01 PREPARATION**

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - 5. Do not proceed until unsatisfactory conditions have been corrected.

#### **3.02 COORDINATION**

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

#### **3.03 INSTALLATION**

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
  - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.

2. Consult with the Owner' Representative and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
3. Protect materials from damage on surfaces subjected to traffic.

#### 3.04 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas. All penetrations are to be labeled in accordance with the University's standard labeling system. The HVAC Contractor shall coordinate all fire stopping requirements with the University prior to start of work.
- B. Keep areas of work accessible until inspection and approval have been completed.
- C. All fire stopping shall be inspected and approved by a licensed independent Consultant. All unapproved fire stopping products installed by this contractor will be removed and replaced at his expense.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

#### 3.05 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

**END OF SECTION**

**SECTION 21 05 20 - PAINTING**

**PART 1 GENERAL**

1.01 REFERENCE

- A. Division 9 - FINISHES
- B. Section 21 05 53 - TAGGING AND CODING

1.02 SCOPE

- A. All steel supports shall be painted by this contractor per Division 9 requirements.
- B. Piping in exposed finished areas shall be painted by this contractor per Division 9 requirements. Mechanical room and shell space piping does not require paint.
- C. Factory finished equipment which has rusted or been damaged shall be cleaned at the completion of the project and rust spots and marred areas shall be refinished and restored to the original factory finish.

**PART 2 PRODUCTS**

- 2.01 Paint shall meet requirements of Division 9 - Finishes

**PART 3 EXECUTION**

Not Applicable

**END OF SECTION**

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**SECTION 21 05 21 - CUTTING AND PATCHING**

**PART 1 GENERAL**

Not Applicable

**PART 2 PRODUCTS**

Not Applicable

**PART 3 EXECUTION**

- 3.01 Cutting for openings, when necessary, shall be done by this Contractor with such tools and methods as to prevent unnecessary damage to surrounding areas or equipment.
- 3.02 The corners of all openings in poured concrete shall be core drilled to minimize overcutting.
- 3.03 Fill space in all areas where core drilled with packing where required to maintain fire rating. Openings shall be temporarily fire-stopped until permanent fire stopping is done. This includes holes left due to removal of piping or ductwork.
- 3.04 All holes cut for the installation of piping, ductwork and equipment shall be neatly patched and refinished with the same materials as, and to match, adjacent surfaces, and damages thereto shall be repaired in kind and to match existing conditions by this Contractor.
- 3.05 Patching shall match existing surfaces in kind and finish.
- 3.06 No structural member will be cut into without the expressed permission of the Owner's representative and structural engineer.

**END OF SECTION**

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## **SECTION 21 05 22 - FOUNDATIONS AND SUPPORTS**

### **PART 1 GENERAL**

#### **1.01 SCOPE**

- A. All concrete foundations and bases for mechanical equipment will be by the General contractor.
- B. This Contractor shall furnish welded steel frames and supports for all equipment requiring same. Furnish auxiliary steel as required for supporting pipes.
- D. This Contractor shall provide concrete foundations for all exterior pipe supports related to his work.

### **PART 2 PRODUCTS**

- 2.01 All steel for frames and supports shall be standard weight black steel pipe or standard structural steel shapes.
- 2.02 All exterior frames and supports shall be galvanized.
- 2.03 Concrete for pads shall be a minimum of 6 bag mix per cubic yard with maximum slump of 4" and shall be air entrained 5 to 7% by volume.

### **PART 3 EXECUTION**

- 3.01 Grind all sharp corners and projections on supporting steel after fabrication. All steel shall have one (1) coat of metal primer after fabrication. All steel supports exposed to the weather shall be finished with a heavy coat of bitumastic.

### **END OF SECTION**

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## SECTION 21 05 29 - INSERTS, PIPE HANGERS, AND SUPPORTS

### PART 1 GENERAL

#### 1.01 SCOPE

- A. Furnish and install all necessary inserts, beam clamps and auxiliary steel for pipe hangers in the building.
- B. Furnish and install necessary pipe hangers and supports to properly support all piping and to maintain uniform elevation.

### PART 2 PRODUCTS

#### 2.01 HANGERS

- A. As specified in sections 21 13 13.
- 2.02 B-Line, F & S, Elcen, Penn, Fee-Mason, PHD Manufacturing or Modern Pipe Hangers of the same type may be furnished at the Contractor's option.

### PART 3 EXECUTION

- 3.01 Riser clamps shall be used at each floor where required.
- 3.02 Wall bracket pipe supports shall be installed where required.
- 3.03 Provide pipe anchors and guides where and as indicated on the Drawings and elsewhere as required to properly control pipe. Method to suit job conditions.
- 3.04 Support piping at pumps and equipment from floor, ceiling, or walls, so that piping weight is not supported directly from pumps or equipment.
- 3.05 All beam clamps and supports for piping and ductwork shall be in place prior to the fireproofing of the structural steel.
- 3.06 Piping to be supported according to the following schedule. Support at intervals not to exceed spacing listed or elsewhere as required in accordance with good workmanship. No pipe shall be supported from another pipe. All hangers shall be plumbed before insulation is applied and all hangers shall be double nutted.

#### SPACING OF HANGERS FOR STEEL PIPE

<u>Pipe Size</u>	<u>Rod</u>	<u>Spacing</u>
Thru 1"	3/8"	7'0"
1-1/4"	3/8"	9'0"
1-1/2"	3/8"	9'0"
2"	3/8"	10'0"
2-1/2"	1/2"	11'0"
3"	1/2"	12'0"

4"	5/8"	14'0"
6"	3/4"	17'0"
8"	7/8"	19'0"
10"	1"	22'0"
12"	1"	23'0"

- 3.07 Support plastic pipe at intervals not to exceed 4 feet, 6 feet on 4 inch and larger.
- 3.08 Support piping at pumps and equipment from floor, ceiling, or walls, so that piping weight is not supported directly from pumps or equipment.

**END OF SECTION**

## **SECTION 21 05 30 - INSTALLATION OF PIPING**

### **PART 1 GENERAL**

#### 1.01 REFERENCE

- A. Section 21 05 29 - INSERTS, PIPE HANGERS AND SUPPORTS
- B. Section 21 05 93 - TESTS AND ADJUSTMENTS
- C. Section 21 13 13 - WET PIPE SPRINKLER SYSTEMS

#### 1.02 SCOPE

- A. The requirements of this Section shall apply to all interior piping systems installed under this Contract, except where otherwise noted on the Drawings or elsewhere in the Specifications.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.01 All piping systems shall be installed with adequate provisions made for expansion and contraction to prevent stresses on piping, valves and equipment. Anchor and guide piping at all points indicated and/or as required. Type and method of anchoring, guiding and attachments to sustaining members to suit job requirements and conditions and shall be approved by University.
- 3.02 Provide unions or flanges at each final connection, and at each piece of equipment. Branches from mains to equipment stubs, risers, etc., to have swing joints with at least one change of direction in the horizontal plane, and one change of direction in the vertical plane, before connecting to equipment or fixtures. Piping shall be arranged and unions and flanges located to permit easy removal of parts and equipment for inspection and cleaning without disconnecting any part except unions or flanges. No welded connections shall be made to valves or equipment. Use bronze unions in copper lines. Unions to be downstream of valves.
- 3.03 Flange bolts shall be cut to proper length so that one thread projects beyond the nut when nut and bolt are tightened.
- 3.04 Make proper connections to all items of equipment in the Contract as recommended by the Manufacturer or as detailed on the Drawings.
- 3.05 All piping shall be arranged in accordance with the best standards of the trade with vertical pipes plumb and horizontal runs parallel or perpendicular to the building wall.
- 3.06 Provide valves and specialties where indicated on the Drawings.
- 3.07 Provide 3/4" drain valves in piping at low points to provide complete drainage of all systems and as shown on the Drawings.
- 3.08 Ream ends of pipe and clean before installing.
- 3.09 All joints in copper piping shall be made with 95-5 solder. Solders and fluxes containing lead are prohibited.

- 3.10 Use pipe dope on male threads of screwed pipe only. Teflon pipe joint tape may be used, at the Contractor's option.
- 3.11 Valves to be installed with handwheel at or above center of pipe. Valves outdoors exposed to weather shall be installed with handwheel in the horizontal.
- 3.12 Make all changes of direction with fittings, rather than bending.
- 3.13 All valves and unions to be installed so as to be accessible through ceiling, access panels, etc.
- 3.14 Provide dielectric unions or insulating flanges between dissimilar metals, i.e., copper to steel.
- 3.15 Bull head connections in any piping service are expressly prohibited.
- 3.16 At the end of each day's work and otherwise as required or directed, provide caps and/or plugs at all openings in piping for protection. Particular attention must be given to avoid the possibility of any foreign materials entering the pipes, whether it be inadvertent or with malicious intent.
- 3.17 Flanged joints shall be faced true and square. Flanges shall be same face style as mating surface to which it is connected.
- 3.18 Install thermometers and gauges so they may be read from floor level.
- 3.19 Where piping is installed in accessible chases, keep all piping to sides of chase, except portions which must necessarily be in center of chase. Offset vents to side immediately above connection to waste line. All lateral runs are to be located at the floor or minimum 6'-0" above floor, and all vertical piping held close to the wall through that height leaving maximum service space.
- 3.20 Where pipe drops occur in block walls, pipes to enter and leave walls at block joints. Coordinate with General Contractor.
- 3.21 Install galvanized sheet metal troughs with drains under pipes crossing electrical equipment. Seal to make water tight.
- 3.22 Do not run water piping through electrical rooms.

**END OF SECTION**

## SECTION 21 05 53 - TAGGING AND CODING

### PART 1 GENERAL

#### 1.01 SCOPE

- A. Provide brass tags on all valves. Tags shall state type of line in which the valve is installed (fire protection piping.) and number of valve. Furnish a schedule or schedules of all valves tagged with number, location and purpose of each valve and mount schedules under glass on Equipment Room wall, or elsewhere as required. Schedules shall be located near and convenient to the valves on the schedule.
- B. In the case of remodeling work when a valve identification system already exists, numbering shall start with the next number after the highest existing number.
- C. After exposed piping is complete, this Contractor shall apply 2" wide color bands on each side of a stenciled legend, lettered with the name of contents of piping. Flow direction arrows of the same colors are to be located adjacent to the Identification Legends. Spacing not over 20 ft. apart and at least once in each room. Do not use adhesive markers. Color per NFPA 13 standards.

### PART 2 PRODUCTS

- 2.01 Valve tags shall be brass minimum 16 gauge.

### PART 3 EXECUTION

Not Applicable

### END OF SECTION

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**SECTION 21 05 54 - EQUIPMENT IDENTIFICATION**

**PART 1 GENERAL**

1.01 SCOPE

- A. This Contractor shall label all disconnects, motor starters, switches and equipment furnished under this Contract.

**PART 2 PRODUCTS**

- 2.01 Labels shall be 1/16" thick laminated plastic nameplates or 0.020" thick aluminum nameplates. Background shall be black with 3/16" letters engraved on the face. Letters shall be white or natural aluminum. Equipment labels shall include the area served by equipment, horsepower, and flow.
- 2.02 After exposed piping and insulation is painted, this Contractor shall apply 2" wide color bands on each side of a stenciled legend, lettered with the name of contents of piping. Flow direction arrows of the same colors are to be located adjacent to the Identification Legends. Spacing not over 20 ft. apart and at least once in each room. Do not use adhesive markers. Color as follows:

Contents	Color	Designation
Fire Protection Water	Red	FP

**PART 3 EXECUTION**

- 3.01 Secure plates with screws. Do not attach to covers where covers can be easily mixed up.

**END OF SECTION**

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**SECTION 21 05 93 - TESTS AND ADJUSTMENTS**

**PART 1 GENERAL**

1.01 SCOPE

- A. After work has been completed but before pipe covering has been applied, the Contractor shall test and adjust the systems he has installed.
- B. The Architect shall be notified of all scheduled tests and adjustments at least 48 hours before they are scheduled so that he may witness same. If the Contractor performs any test or adjustment without the Architect present or without properly notifying the Architect, the Contractor will be required to perform the test or adjustment a second time in the presence of the Architect.
- C. If the Architect determines that any work requires special inspection, testing, or approval, they will, upon written authorization, instruct the Contractor to order such special inspection, testing or approval. The Contractor shall give timely notice so the Architect may observe the inspections, tests or approvals. If such special inspection or testing reveals a failure of the work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the Architect's additional services made necessary by such failure; otherwise the owner shall bear such costs, and an appropriate Change Order shall be issued.
- D. Concealed lines shall be tested before being concealed. If this is not done and a leak appears during the final test, this Contractor shall repair leak and all damage resulting therefrom.
- E. This Contractor shall adjust all his equipment in the mechanical system to obtain proper operation and shall demonstrate to Owner and the Architect that the entire system will function properly.

**PART 2 PRODUCTS**

Not Applicable

**PART 3 EXECUTION**

- 3.01 After work has been completed but before pipe covering has been applied, the Contractor shall test the systems as follows. At these pressures, the circulation shall be free and the piping free of leaks. Verify with the Owners Insurance Underwriter that the testing procedure listed is adequate for their standards.

System	Test Medium	Pressure Not Less Than	Time Not Less Than	Notes
Sprinkler system	Water	200 lbs	3 hrs	no drop

- 3.02 Before turning job over to Owner, inspect all valves and repack valves as necessary.
- 3.03 This Contractor shall adjust all equipment in the mechanical system to obtain proper operation and shall demonstrate to Owner and the Architect that the entire system will function properly.

**END OF SECTION**



**SECTION 21 05 94 - PROTECTION AND CLEANING**

**PART 1 GENERAL**

Not Applicable

**PART 2 PRODUCTS**

Not Applicable

**PART 3 EXECUTION**

- 3.01 Protect all mechanical/electrical equipment against damage from any cause whatsoever and pay the cost of replacing and repairing equipment made necessary by failure to provide suitable protection.
- 3.02 After all piping and equipment has been approved and after all plastering has been completed, bare piping and insulation provided under this Contract shall be thoroughly cleaned of dirt, grease, rust and oil.
- 3.03 Repair all dents and scratches in factory prime or finish coats on all mechanical equipment to the satisfaction of Associate. If damage is excessive, replacement may be required.
- 3.04 Flush out all piping systems to remove all dirt and grease from pipes and equipment before systems are placed in operation.
- 3.05 Cover all pumps, open pipes, etc., to keep out dirt, water and weather during construction.
- 3.06 This Contractor shall clean up and remove all debris from the site and shall at all times keep the premises in a neat and orderly condition.

**END OF SECTION**

OHIO UNIVERSITY  
OHIO MUSEUM COMPLEX  
LIN HALL HVAC

CONSTRUCTION DOCUMENTS  
JANUARY 9, 2024  
OU PROJECT 23002

## SECTION 21 06 00 - MANUFACTURER'S DRAWINGS

### PART 1 GENERAL

#### 1.01 SCOPE

- A. The Contractor shall submit for review six (6) copies of fire protection equipment submittals, hydraulic calculations and sprinkler layout drawings, etc as noted below in three distinct sequential stages:
1. **Materials and Equipment List:** Include all materials, equipment, and accessories required for work. Include catalog ID numbers, drawings, cut sheets as necessary to define the work. If cut sheets include multiple selections, and or optional selections, then clearly label the included sections and the included options. Submit to the Architect for review.
  2. **Preliminary Shop Drawings:** Include sprinkler head locations only. Include full-size detail representation of each style of sprinkler head to be used. Submit to the Architect for review.
  3. **Detailed Shop Drawings:** Include pipe layout and sizing, sprinkler head locations coordinated onto reflected ceiling drawings, hydraulic calculations, system controls, and all equipment cut sheets, zone valves, zone drain valves, and zone test stations. Submit to all required parties, Architect, Authority Having Jurisdiction (AHJ), the local Fire Chief, State Fire Marshal, and the Owner's Insurance Underwriter, for review and approval by all.
- B. The Assocaite will review Contractor's shop drawings and related submittals (as indicated above and below) with respect to the ability of the detailed work, when complete, to be a properly functioning integral element of the overall system designed by the Assocaite. Before submitting a shop drawing or any related material to the Assocaite, Contractor shall: review each such submission for conformance with the means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto, all of which are the sole responsibility of Contractor; approve each such submission before submitting it; and so stamp each such submission before submitting it. The Assocaite shall assume that no shop drawing or related submittal comprises a variation unless Contractor advises Assocaite otherwise via a written instrument which is acknowledged by Assocaite in writing. The shop drawings and related material (if any) called for are indicated below:

#### Fire Protection Contract

Sprinkler Drawings  
Fire Protection Equipment  
Pipe, Hangers, and Fittings  
Sprinkler Heads  
Hydraulic Calculations  
Tamper Switches  
Flow Switches  
Hose Valves  
Floor Control Valve Assemblies

- C. The Assocaite shall return shop drawings and related materials with comments provided that each submission has been called for and is stamped by Contractor as indicated above. The Assocaite

shall return without comment material not called for or which has not been approved by Contractor.

- D. This Contractor shall furnish equipment shop drawings which will indicate power hook up and control connections as required for mechanical equipment. "Stock" wiring diagrams are NOT ACCEPTABLE.
- E. The HVAC Contractor is to provide sepias of sheet metal drawings for use in coordinating work of Plumbing, Fire Protection and Electrical with layout of air distributions system and related work. Lighting, ceiling grid and ceiling access doors will be shown lightly to verify coordination. HVAC Contractor to provide initial sepias within 60 days of award of contract. Each Prime Contractor is responsible for overlaying his work onto these sepias; for providing information as to size, elevation and location proposed for all components; and for coordination of his work with that of other Contractors. Final resolution of all items to be determined at project meetings held by Lead Contractor.
- F. Assocaite's review of manufacturer's drawings or schedules shall not relieve the Contractor from compliance with the requirements of the plans and specifications.

1.02 QUANTITIES

- A. Items may be referred to in singular or plural on Plans and Specifications. Contractor is responsible for determining quantity of each item.

**PART 2 PRODUCTS**

Not Applicable

**PART 3 EXECUTION**

Not Applicable

**END OF SECTION**

## SECTION 21 13 13 - 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. This Section includes the following fire-suppression piping inside the building:
  - 1. Manual wet-type, Class I standpipe systems.
  - 2. Wet-Pipe Sprinkler System.
- B. Related Sections include the following:
  - 1. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
  - 2. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.

#### 1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

#### 1.4 SYSTEM DESCRIPTIONS

- A. Combined Standpipe and Sprinkler System: Fire-suppression system with both standpipe and sprinkler systems. Sprinkler system is supplied from standpipe system.
- B. Manual Wet-Type, Class I Standpipe System: Includes NPS 2-1/2 hose connections. Has small water supply to maintain water in standpipes. Piping is wet, but water must be pumped into standpipes to satisfy demand.
- C. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. 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 Piping System Component Working Pressure: Listed for at least 175 psig.
- B. Fire-suppression standpipe system design shall be approved by authorities having jurisdiction.

1. Minimum residual pressure at each hose-connection outlet is the following:
    - a. NPS 2-1/2 Hose Connections: 50 psig.
  2. Unless otherwise indicated, the following is maximum residual pressure at required flow at each hose-connection outlet:
    - a. NPS 2-1/2 Hose Connections: 175 psig.
- C. Fire-suppression sprinkler system design shall be approved by 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:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1.
    - d. Laundries: Ordinary Hazard, Group 1.
    - e. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - f. Office and Public Areas: Light Hazard.
    - g. Residential Living Areas: Light Hazard.
  3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 2500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
  4. Maximum Protection Area per Sprinkler: Per UL listing.
  5. Maximum Protection Area per Sprinkler:
    - a. Office Spaces: 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.
  6. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

#### 1.6 SUBMITTALS

- A. Product Data: For the following:
1. Piping materials, including dielectric fittings, flexible connections, and sprinkler specialty fittings.
  2. Pipe hangers and support.
  3. Valves, including listed fire-protection valves, unlisted general-duty valves, and specialty valves and trim.
  4. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  5. Hose connections, including size, type, and finish.
  6. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Fire-hydrant flow test and reports shall be performed and furnished by the contractor.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Submittal to Factory Mutual will be required of the contractor.



- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14 and Factory Mutual. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Welding certificates.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For standpipe and 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 fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
    - a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.
- B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- C. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
  - 1. NFPA 13, "Installation of Sprinkler Systems."
  - 2. NFPA 14, "Installation of Standpipe, Private Hydrant, and Hose Systems."
  - 3. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."
  - 4. NFPA 230, "Fire Protection of Storage."

#### 1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

#### 1.9 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. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, 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 on Project.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

## 2.2 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
  - 1. Cast-Iron Threaded Flanges: ASME B16.1.
  - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 3. Gray-Iron Threaded Fittings: ASME B16.4.
  - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
  - 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Grooved-End, Standard-Weight Schedule 40 Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
  - 1. Grooved-Joint Piping Systems:
    - a. Manufacturers:
      - 1) Anvil International, Inc.
      - 2) National Fittings, Inc.
      - 3) Southwestern Pipe, Inc.
      - 4) Star Pipe Products; Star Fittings Div.
      - 5) Victaulic Co. of America.
      - 6) Ward Manufacturing.
    - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
    - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD.

2.3 Piping down-stream of the sprinkler zone control valve assemblies only may be plenum rated ASTM/fire protection service listed SDR 13.5 CPVC pipe with socket solvent weld pressure fittings rated for 175 psig working pressure. Provide listed adapter/transition fittings for integration of threaded fire protection components. All hangers and supports shall be spaced at 1/2 the Manufacturer recommended spacing to provide greater support and restrict sagging/settling of piping after installation. Installation shall be in full accordance with the Manufacturer's recommendations and NFPA 13.

## 2.4 FLEXIBLE CONNECTORS

- A. Flexible connectors shall have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
  - 1. NPS 2 and Smaller: Threaded.
  - 2. NPS 2-1/2 and Larger: Flanged.
- B. Manufacturers:
  - 1. Anamet Inc.
  - 2. Flex-Hose Co., Inc.
  - 3. Flexicraft Industries.
  - 4. Flex-Pression, Ltd.
  - 5. Flex-Weld, Inc.
  - 6. Hyspan Precision Products, Inc.
  - 7. Mercer Rubber Co.
  - 8. Metraflex, Inc.
  - 9. Proco Products, Inc.
  - 10. Unaflex Inc.

- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

## 2.5 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Outlet Specialty Fittings:
  - 1. Manufacturers:
    - a. Anvil International, Inc.
    - b. Central Sprinkler Corp.
    - c. Ductilic, Inc.
    - d. JDH Pacific, Inc.
    - e. National Fittings, Inc.
    - f. Shurjoint Piping Products, Inc.
    - g. Southwestern Pipe, Inc.
    - h. Star Pipe Products; Star Fittings Div.
    - i. Victaulic Co. of America.
    - j. Ward Manufacturing.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.
  - 1. Manufacturers:
    - a. Central Sprinkler Corp.
    - b. Fire-End and Croker Corp.
    - c. Viking Corp.
    - d. Victaulic Co. of America.
- C. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
  - 1. Manufacturers:
    - a. AGF Manufacturing Co.
    - b. Central Sprinkler Corp.
    - c. G/J Innovations, Inc.
    - d. Triple R Specialty of Ajax, Inc.
- D. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.
  - 1. Manufacturers:
    - a. CECA, LLC.
    - b. Merit.

## 2.6 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Valves shall have pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:
  - 1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
  - 2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with operating wrench, extension rod, locking device, and cast-iron barrel.

3. Manufacturers:
    - a. Hammond Valve.
    - b. Kennedy Valve; a division of McWane, Inc.
    - c. Watts Industries, Inc.; Water Products Div.
  - C. Butterfly Valves: UL 1091.
    1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
      - a. Manufacturers:
        - 1) Hammond Valve.
        - 2) Kennedy Valve; a division of McWane, Inc.
        - 3) Watts Industries, Inc.; Water Products Div.
  - D. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
    1. Manufacturers:
      - a. Hammond Valve.
      - b. Kennedy Valve; a division of McWane, Inc.
      - c. Watts Industries, Inc.; Water Products Div.
  - E. Gate Valves: UL 262, OS&Y type.
    1. NPS 2 and Smaller: Bronze body with threaded ends.
      - a. Manufacturers:
        - 1) Hammond Valve.
        - 2) Kennedy Valve; a division of McWane, Inc.
        - 3) Watts Industries, Inc.; Water Products Div.
    2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.
      - a. Manufacturers:
        - 1) Hammond Valve.
        - 2) Kennedy Valve; a division of McWane, Inc.
        - 3) Watts Industries, Inc.; Water Products Div.
  - F. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.
    1. Indicator: Electrical, 115-V ac, prewired, 2-circuit, supervisory switch.
    2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.
      - a. Manufacturers:
        - 1) Hammond Valve.
        - 2) Kennedy Valve; a division of McWane, Inc.
        - 3) Watts Industries, Inc.; Water Products Div.
    3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.
      - a. Manufacturers:
        - 1) Hammond Valve.
        - 2) Kennedy Valve; a division of McWane, Inc.
        - 3) Watts Industries, Inc.; Water Products Div.
- 2.7 UNLISTED GENERAL-DUTY VALVES
- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
  - B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

## 2.8 SPECIALTY VALVES

- A. Sprinkler System Control Valves: UL listed or FMG approved, cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating.
  - 1. Manufacturers:
    - a. AFAC Inc.
    - b. Globe Fire Sprinkler Corporation.
    - c. Reliable Automatic Sprinkler Co., Inc.
    - d. Star Sprinkler Inc.
    - e. Victaulic Co. of America.
    - f. Viking Corp.
  - 2. Alarm Check Valves: UL 193, designed for horizontal or vertical installation, with bronze grooved seat with O-ring seals, single-hinge pin, and latch design. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, and fill-line attachment with strainer.
    - a. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.
    - b. Drip Cup Assembly: Pipe drain with check valve to main drain piping.
- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.
  - 1. Manufacturers:
    - a. AFAC Inc.
    - b. Grinnell Fire Protection.

## 2.9 SPRINKLERS

- A. Sprinklers shall be UL listed and FMG approved, with 175-psig minimum pressure rating.
- B. Manufacturers:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Gem Fire Protection.
  - 3. Reliable Automatic Sprinkler Co., Inc.
  - 4. Victaulic Co. of America.
  - 5. Viking Corp.
- C. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 199, for nonresidential applications.
  - 2. UL 1767, for early-suppression, fast-response applications.
- D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
- E. Sprinkler types, features, and options as follows:
  - 1. Concealed ceiling sprinklers, including cover plate.
  - 2. Flush ceiling sprinklers, including escutcheon.
  - 3. Pendent sprinklers.
  - 4. Quick-response sprinklers.
  - 5. Recessed sprinklers, including escutcheon.
  - 6. Sidewall sprinklers.
  - 7. Upright sprinklers.
- F. Sprinkler Finishes: Chrome plated, bronze, and painted.

- G. 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.
- H. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.10 HOSE CONNECTIONS

- A. Manufacturers:
  - 1. Elkhart Brass Mfg. Co., Inc.
  - 2. Fire-End and Croker Corp.
  - 3. Guardian Fire Equipment Incorporated.
  - 4. Potter-Roemer; Fire-Protection Div.
- B. Description: UL 668, brass or bronze, 300-psig minimum pressure rating, hose valve for connecting fire hose. Include angle or gate pattern design; female NPS inlet and male hose outlet; and lugged cap, gasket, and chain. Include NPS 2-1/2 as indicated, and hose valve threads according to NFPA 1963 and matching local fire department threads.
  - 1. Valve Operation: Nonadjustable type.
  - 2. Finish: Rough chrome-plated.

## 2.11 ALARM DEVICES

- A. Alarm-device types shall match piping and equipment connections.
- B. Electrically Operated Alarm: UL 464, with 6-inch- minimum- diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
  - 1. Manufacturers:
    - a. Potter Electric Signal Company.
    - b. System Sensor.
- C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.
  - 1. Manufacturers:
    - a. ADT Security Services, Inc.
    - b. Grinnell Fire Protection.
    - c. ITT McDonnell & Miller.
    - d. Potter Electric Signal Company.
    - e. System Sensor.
    - f. Viking Corp.
    - g. Watts Industries, Inc.; Water Products Div.
- D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow.
  - 1. Manufacturers:
    - a. Grinnell Fire Protection.
    - b. Potter Electric Signal Company.
    - c. System Sensor.

- d. Viking Corp.
  - E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.
    - 1. Manufacturers:
      - a. McWane, Inc.; Kennedy Valve Div.
      - b. Potter Electric Signal Company.
      - c. System Sensor.
- 2.12 PRESSURE GAGES
- A. Manufacturers:
    - 1. AGF Manufacturing Co.
    - 2. AMETEK, Inc.; U.S. Gauge.
    - 3. Brecco Corporation.
    - 4. Dresser Equipment Group; Instrument Div.
    - 5. Marsh Bellofram.
    - 6. WIKA Instrument Corporation.
  - B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
    - 1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
    - 2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

### **PART 3 - EXECUTION**

#### 3.1 PREPARATION

- A. Perform fire-hydrant flow test according to NFPA 13, NFPA 14 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.
- B. Report test results promptly and in writing.

#### 3.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

#### 3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.4 PIPING APPLICATIONS, GENERAL

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.

- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
- E. Underground Service-Entrance Piping: Ductile-iron, grooved-end pipe and fittings; grooved-end-pipe couplings; and grooved joints. Include corrosion-protective encasement.

### 3.5 STANDPIPE SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Type Standpipe System, 175-psig Maximum Working Pressure:
  - 1. NPS 4 and Smaller: Threaded-end, black, standard-weight schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
  - 2. NPS 4 and Smaller: Grooved-end, black, standard-weight schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
  - 3. NPS 6: Threaded-end, black, standard-weight schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
  - 4. NPS 6: Grooved-end, black, standard-weight schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
  - 5. NPS 8: Threaded-end, black, standard-weight schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
  - 6. NPS 8: Grooved-end, black, standard-weight schedule 40 steel pipe with square-cut- or roll-grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

### 3.6 SPRINKLER SYSTEM PIPING APPLICATIONS

- A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:
  - 1. NPS 2 and Smaller: Threaded-end, black standard-weight schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
  - 2. NPS 2-1/2 to NPS 4: Threaded-end, black, standard-weight schedule 40 steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
  - 3. NPS 2-1/2 to NPS 4: Grooved-end, black, standard-weight schedule 40 steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

### 3.7 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Listed Fire-Protection Valves: UL listed and FMG approved for applications where required by NFPA 13 and NFPA 14.
    - a. Shutoff Duty: Use ball, butterfly, or gate valves.
  - 2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13 and NFPA 14.
    - a. Shutoff Duty: Use ball, butterfly, or gate valves.

### 3.8 JOINT CONSTRUCTION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping joint construction.



- B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40.
- C. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
  - 1. Ductile-Iron Pipe: Radius-cut-groove ends of piping. Use grooved-end fittings and grooved-end-pipe couplings.
  - 2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

### 3.9 SERVICE-ENTRANCE PIPING

- A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 22 Section "Facility Water Distribution Piping" for exterior piping.
- B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 22 Section "Facility Water Distribution Piping" for backflow preventers.
- C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

### 3.10 WATER-SUPPLY CONNECTION

- A. Connect fire-suppression piping to building's exterior water distribution piping.

### 3.11 PIPING INSTALLATION

- A. Refer to Division 21 Section "Common Work Results for Fire Suppression" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.

- I. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.
- J. Install drain valves on standpipes.
- K. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- L. Install alarm devices in piping systems.
- M. Hangers and Supports: Comply with NFPA 13 for hanger materials.
  - 1. Install standpipe system piping according to NFPA 14.
  - 2. Install sprinkler system piping according to NFPA 13.
- N. 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.
- O. Fill wet-standpipe system piping with water.
- P. Fill wet-pipe sprinkler system piping with water.

### 3.12 VALVE INSTALLATION

- A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and NFPA 14 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.

### 3.13 SPRINKLER APPLICATIONS

- A. Drawings indicate sprinkler types to be used. Where specific types are not indicated, use the following sprinkler types:
  - 1. Rooms without Ceilings: Upright sprinklers.
  - 2. Rooms with Suspended Ceilings: Recessed and concealed sprinklers, as indicated.
  - 3. Wall Mounting: Sidewall sprinklers.
  - 4. Sprinkler Finishes:
    - a. Upright, Pendent, and Sidewall 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.
    - b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
    - c. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.

### 3.14 SPRINKLER INSTALLATION

- A. Install sprinklers in suspended ceilings in center of narrow dimension of acoustical ceiling panels and tiles.

- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

### 3.15 HOSE-CONNECTION INSTALLATION

- A. Install hose connections adjacent to standpipes, unless otherwise indicated.
- B. Install NPS 2-1/2 hose-station valves.

### 3.16 FIRE DEPARTMENT CONNECTION INSTALLATION

- A. Install ball drip valve at each check valve for fire department connection.

### 3.17 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.
- C. Connect water-supply piping to fire-suppression piping.
- D. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.
- E. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- F. Electrical Connections: Power wiring is specified in Division 26.
- G. Connect alarm devices to fire alarm.
- H. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- I. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- J. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.18 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14.

### 3.19 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
  1. Leak Test: After installation, charge system 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. Energize circuits to electrical equipment and devices.
  4. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.

5. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
6. Coordinate with fire alarm tests. Operate as required.
7. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

### 3.20 CLEANING AND PROTECTION

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers with paint other than factory finish.
- C. Protect sprinklers from damage until Substantial Completion.

### 3.21 DEMONSTRATION

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

**END OF SECTION**

**PLUMBING SPECIFICATIONS - INDEX**

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## **SECTION 22 00 00 - PLUMBING GENERAL**

### **PART 1 GENERAL**

#### **1.01 REFERENCE**

- A. Sections 22 00 00 through 22 06 00 (as included), for items of a general nature which apply to the Plumbing Contract, unless indicated otherwise herein.
- B. Sections 22 07 19 through 22 40 00 (as included), cover Plumbing work specifically.
- C. Applicable Division 1 and General Conditions terms and conditions (if any).
- D. Applicable construction codes, standards and guidelines for all Plumbing Contract elements, including but not limited to the following:
  - 1. City of Athens, Ohio Building Code, including Plumbing, Fuel Gas, Mechanical, handicap accessibility and energy conservation portions thereof.
  - 2. City of Athens Board of Health.
  - 3. State of Ohio Environmental Protection Agency (E.P.A.).
  - 4. NFPA pamphlet no. 70, NATIONAL ELECTRIC CODE
  - 5. City of Athens Division of Water utility provider.
  - 6. City of Athens Sewer and Drain authority.
  - 7. American National Standards Institute (ANSI) standards for materials and construction.
  - 8. American Society of Mechanical Engineers (ASME) standards for materials and construction.
  - 9. American Society of Sanitary Engineering (ASSE) standards for performance and testing.
  - 10. American Society for Testing and Materials (ASTM) standards for materials, construction and testing.
  - 11. American Water Works Association (AWWA) standards for materials, construction and disinfection procedures.
  - 12. National Sanitation Foundation (NSF) standards for materials and construction.
  - 13. Cast Iron Soil Pipe Institute (CISPI) standards for materials and construction.
  - 14. Underwriter's Laboratories (UL) standards for materials and construction.
  - 15. The manufacturer's installation guidelines and recommendations for individual items, elements and/or systems indicated herein.
  - 16. The Owner's material and installation guidelines and/or standards.

1.02 SCOPE

- A. This Contractor shall furnish all labor, materials, tools, incidentals, details, etc., necessary to provide a complete, operational and approved Plumbing System, including but not limited to all items and elements described in the Plumbing Specification and shown on the Plumbing Drawings, and as required for coordination and/or interface with work under separate contract as indicated by complete construction documentation package.
- B. The Plumbing Contractor is responsible for satisfactorily addressing all review and inspection authorities' requirements and directives in regard to methods of installation necessary for final approval.

1.03 PERMITS AND FEES

- A. Unless directed otherwise by the General Conditions portion of project documentation, the Plumbing Contractor shall apply for and pay any review, inspection, permit, license, testing and/or other service fees required by all review/inspection/approval authorities in connection with the work under this Contract.
- B. Unless directed otherwise by the General Conditions portion of project documentation, the Plumbing Contractor shall apply for and pay any procurement, tap, capacity, metering, testing and/or other service fees required by all Utility Providers (Water, Gas, Storm, Sewer etc.) in connection with the work under this Contract. This shall include procurement, execution and return of any forms and/or applications required; and participation in individual, initial design/installation consultations with the providers if required.

1.04 PLUMBING UTILITY CONNECTIONS FOR ITEMS OR ELEMENTS NOT INCLUDED IN THE PLUMBING CONTRACT

- A. Provide Plumbing supply, waste, drain, vent, and any other piped utilities included for the project as required, as listed herein, and/or as shown on the Plumbing Drawings for items furnished and/or installed under separate contract requiring same. These items shall include, but not be limited to the following:
  - 1. HVAC equipment; final connection (where applicable) by the HVAC Contractor.
  - 2. Owner provided items; final connection (where applicable) by the Plumbing Contractor.
- B. Rough-in Plumbing supply, waste, drain, vent, and any other piped utilities included for the project as required, as listed herein, and/or as shown on the Plumbing Drawings for all future items requiring same.

- 1.05 Concrete housekeeping and support pads for equipment in the Plumbing Contract are the responsibility of the Plumbing Contractor. Concrete pad construction to be in accordance with specifications provided in the General Contract for same.

**PART 2 PRODUCTS**

- 2.01 Where items/elements are indicated herein to be listed/approved, the intent of this specification is that said item/element shall be listed by all applicable material/construction standards and subject to final approval (including methods of installation) by all review/inspection/approval authorities.

- 2.02 Unless indicated otherwise, all plumbing contract items/elements (pipe, fittings, valves, specialties, fixtures, equipment, etc.) materials, construction, performance, testing and methods of installation to be as listed/approved by all applicable material/construction/installation standards for same, and be in accordance with the requirements of all review/inspection/approval authorities. This includes, but is not limited to, the standards and authorities referenced in this specification. In the absence of such standards and/or requirements, the item/element manufacturer's recommendations, as confirmed by the Plumbing Contractor in advance, shall be followed.
- 2.03 Unless indicated otherwise, all Plumbing piping shall be in accordance with the following standards in regard to materials, construction, dimensions/tolerances, type of service/transmission medium (water, air, gas, etc.) and methods of installation (as applicable), and shall be so listed. Final approval for use is subject to the requirements of the review and inspection authorities:
- A. Steel pipe, steel, malleable and cast iron fittings and joining methods; per applicable ASTM/ANSI/ASME standards. In addition, where utilized for potable water service, all elements shall be per applicable NSF and ASTM A53 (for carbon steel) standards.
  - B. Ductile iron pipe, fittings and joining methods; per applicable ASTM/ANSI/ASME/AWWA/NSF standards.
  - C. Plastic pipe, fittings and joining methods; per applicable ASTM/ANSI/ASME/AWWA/NSF standards.
  - D. Cast iron pipe, fittings and joining methods; per applicable ASTM/ANSI/ASME/CISPI standards.
  - E. Copper/copper alloy/brass pipe/tube, fittings and joining methods; per applicable ASTM/ANSI/ASME standards. In addition, where utilized for potable water service, all elements shall be per applicable NSF standards.
- 2.04 All Plumbing Contract items/elements shall have the manufacturer's mark or name and the quality of the product or identification of same cast, embossed, stamped or indelibly marked on each item/element in accordance with the standards under which they are accepted and approved per applicable code(s).
- 2.05 PLUMBING UTILITY CONNECTIONS PROVIDED FOR ITEMS OR ELEMENTS NOT INCLUDED IN THE PLUMBING CONTRACT
- A. Unless indicated otherwise, the Plumbing Contractor shall furnish and install all traps and stops (as applicable) as required for items furnished under separate contract. This includes items with connections by the Plumbing Contractor or with connections under separate contract.
  - B. Unless indicated otherwise, Fixture traps above floor slab connected to the sanitary waste system shall be cast brass P-traps with integral cleanout. P-traps below floor slab to be cast iron, less cleanout. See plans for sizes.
  - C. Unless indicated otherwise, Fixture traps connected to waste or drain systems other than the sanitary waste system shall be of same material and connection type as the associated piping system. P-trap or S-trap to be provided as indicated on plans.
  - D. Unless indicated otherwise, All waste and drain rough-ins for future shall terminate with a short nipple and cap and no trap.



- E. Unless indicated otherwise, Supply rough-ins to be furnished with accessible shut-offs at connection points. Shut-offs at supply rough-ins for fixtures (sinks, lavatories, etc.) to be angle type compression stops. Shut-offs at supply rough-ins for equipment or other elements to be in-line valves as specified for individual services. All supply rough-ins for future shall terminate with a short nipple and cap immediately downstream of the shut-off.
- F. Unless indicated otherwise, where connection elements described herein are exposed in locations other than restricted access utility or maintenance areas, all metallic components to be furnished with a polished chrome finish. Wall or other structure piping penetrations at these locations to be provided with polished chrome finish escutcheons.

### **PART 3 EXECUTION**

- 3.01 Where standards, codes or guidelines are referenced herein and throughout the Plumbing Contract documentation, including plans and specifications, the latest version/edition shall be applied, unless the Building Code references another version/edition, which shall take precedence.
- 3.02 Refer to project documentation furnished with the complete construction package in advance of work for overall coordination and verification of requirements at work of other trades relating to, interfacing with, and/or impacting work in the Plumbing Contract. This includes exact locations, quantities, physical sizes, rough-in details, pipe routing, connection sizes, etc., for items included both in the Plumbing Contract and under separate contract. Coordinate installation and interface requirements with the appropriate contractor(s) in advance of work.
- 3.03 Include any minor details, items and/or elements essential to necessary approvals and successful operation in addition to the items specified herein and shown on plans.
- 3.04 See general "PLUMBING NOTES" on plans for additional conditions and requirements relative to the Plumbing Contract.
- 3.05 Plumbing items and elements shall be installed with due regard to preservation of the strength of structural members and prevention of damage to walls, surfaces and other structures through installation, bearing support or subsequent usage of Plumbing items and elements. No framing or other support structure shall be cut, notched or bored in excess of limitations specified in the Building Code, or by the manufacturer of the framing or other support structure, as confirmed in advance of work by the Plumbing Contractor.

### **END OF SECTION**

## SECTION 22 01 05 - PLUMBING GENERAL PROVISIONS

### PART 1 GENERAL

#### 1.01 GENERAL REQUIREMENTS

- A. Furnish all labor, materials, tools, incidentals and details necessary to provide a complete mechanical system, ready to operate, including but not limited to the items listed under the Mechanical Specification Indexes.
- B. Include any minor details essential to successful operation and any other items specified or shown on the Drawings.
- C. The Contractor is required to read the Specifications covering all branches of the work and will be held responsible for coordination of his work with work performed under all other Contracts.
- D. The Contractor is required to visit the site and fully inform himself concerning all conditions affecting the scope of his work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his Contract.
- E. The Contractor should feel free to contact the Architect immediately if there is any question regarding the meaning or intent of either Plans or Specifications, or if he notices any discrepancies or omissions in either Plans or Specifications.
- F. Other than minor adjustments shall be submitted to the Architect for approval before proceeding with the work.
- G. The Contractor shall submit on his letterhead, along with the Bid, the manufacturer's name and the names of all Subcontractors to whom he intends to sublet the work. If the Contractor fails to provide this information with the Bid, the Owner shall have the right to select the manufacturers and Subcontractors with no additional charge.
- H. Scheduling of all work performed by this Contractor shall be completely coordinated with the Construction Manager.
- I. This Contractor shall furnish to Architect a written description of procedure on this job including scheduling of the work to be done for his approval. This shall be submitted within 10 days after the Contract is awarded. There shall be six (6) copies.
- J. All material hoisting by trade involved.
- K. Arrangements for storage of tools and material, removal of debris, and interruptions of services shall be made with the Construction manager.
- L. Extreme care shall be taken to avoid interference and/or conflict with work of other trades. Consult with the Architect regarding any points where interference and/of

conflict is likely to occur and follow dimensions carefully where given on the Drawings. Pay particular attention to minimum clear heights when indicated on the Drawings.

- M. It is mandatory that dust and debris be held to a minimum. This Contractor shall provide drop cloths, screens, curtains, etc., to protect all equipment and personnel from dust and dirt during the course of his work. All damage to existing construction or finishes shall be repaired by this Contractor upon removal of dirt and dust protection devices. All dirt, dust and other protection devices shall be approved by the Construction Manager before any work is started in the area involved.
- N. The Contractor, insofar as this Contract is concerned, shall at all times keep the premises and the building in a neat and orderly condition.
- O. At the completion of the project, this Contractor shall promptly clean up and remove from the site, all debris and excess materials.

#### 1.02 DRAWINGS

- A. Consult all Contract Drawings which may affect the locations of any equipment, apparatus, piping and ductwork and make minor adjustments in location to secure coordination.
- B. Piping and duct layout is schematic and exact locations shall be determined by structural and other conditions and verified in the field. This shall not be construed to mean that the design of the system may be changed, it refers only to the exact location of piping and ductwork to fit into the building as constructed, and to coordination of all work with piping and equipment included under other Divisions of the Specifications.
- C. The layout shown on the Drawings is based on a particular make of equipment. If another make of equipment is used which requires modifications or changes of any description from the Drawings or Specifications, this Contractor shall be responsible for making all such modifications and changes, including those involving other trades, as a part of this Contract and the cost thereof shall be included in his Bid. In such case, the Contractor shall submit Drawings and Specifications showing all such modifications and changes prior to starting work, which shall be subject to the approval of the Architect.
- D. The Owner and Architect reserves the right to make minor changes in the location of piping and equipment up to the time of rough-in without additional cost to the Owner.
- E. Where certain grades and/or elevations are given on the Drawings, they have been obtained from the best information available; however, they are not guaranteed. This Contractor MUST assume the full responsibility of verifying present elevations in the field and making any adjustments as may be necessary, all of which must be included in his Bid Price.
- F. Due to the scale of the Drawings, it is impossible to show all offsets and transitions which may be required. This Contractor shall carefully investigate the conditions

affecting all work and shall furnish all elbows, fittings, transitions, etc., required to accomplish the desired result at no additional cost to the Owner.

- G. Install all work as close as possible to walls, ceilings, struts, members, etc., consistent with the proper space for covering, access, etc., so as to occupy the minimum of space.
- H. Actual dimensions shown on the Drawings and field dimensions shall take precedence over scaled dimensions.

#### 1.03 PERMITS, INSPECTIONS AND CODES

- A. The Architect will obtain the general building permit. Any other permits required for the project will be obtained by the Contractor performing the work. Fees will be included in the bid price.
- B. Completed installations shall conform with all applicable Federal, State and Local Laws, Codes and Ordinances, including but not limited to the latest editions of the following:
  - 1. Ohio Building Code, State of Ohio.
  - 2. A.S.M.E. Pressure Piping Code - Section B31.1
  - 3. National Electrical Code, Bulletin No. 70, National Fire Protection Association.
  - 4. Life Safety Code, Bulletin No. 101, National Fire Protection Association.
- C. Nothing contained in the Plans and Specifications shall be construed to conflict with these laws, codes and ordinances and they are hereby made a part of these Specifications.

#### 1.04 OHIO ENERGY CODE

- A. The Mechanical System must comply with all requirements of the State of Ohio "Code for Energy Conservation". This includes, but is not limited to, efficiencies, power factors, insulation thickness, etc.

#### 1.05 UTILITIES

- A. The Contractor shall investigate and locate all utilities prior to construction.
- B. Each Contractor is responsible for rerouting or replacing existing utilities where necessary to permit installation of his work.
- C. Support, protection and restoration of all existing utilities and appurtenances shall be the responsibility of the Contractor. The cost of this work shall be included in the price bid for the various items.

- D. The Contractor shall cause notice to be given to the Ohio Utilities Protection Service (telephone 800-362-2764 - toll- free) and to the Owners of underground utility facilities shown on the plans who are not members of a registered underground protection service in accordance with Section 153.64 of the Revised Code. The above mentioned notice shall be given at least 48 hours, excluding Saturdays, Sundays and legal holidays, prior to commencing work.
- E. The Contractor shall alert immediately the occupants of nearby premises as to any emergency that he may create or discover on or near such premises of the underground facility, any break or leak on its lines or any dent, gouge, groove or other damage.

#### 1.06 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. This Contractor shall thoroughly instruct and supervise the Owner's Maintenance Personnel in the proper operation and maintenance of the mechanical system equipment. This Contractor shall be responsible for arranging for the instruction and supervision at a time convenient to the Owner and notifying the Architect of the time at least 48 hours in advance.

Instructions shall include the following:

- 1. Location of equipment and explanation of what it does.
  - 2. Reference to "Operating Instruction Manuals" for record and clarity.
  - 3. Coordination of written and verbal instruction so that each is understood by all personnel.
  - 4. Specific maintenance to be performed by the Owner.
- B. Furnish one (1) copy of the printed Operating and Maintenance Instructions for the Mechanical Systems for review. Copy shall be neat, legible and bound in a hardback 3-ring notebook. After final approval, provide four (4) copies of Operation and Maintenance Instructions for submittal to the Owner. Instructions shall consist of the following items:
    - 1. Title Page: Title of Project, address, date of submittal, name and address of Contractor, name of Architect.
    - 2. Second Page: Index of Manual Contents.
    - 3. First Section: A copy of each approved shop drawing and submittal with an index at the beginning of the section.
    - 4. Second Section: A list of all equipment used on the project, together with supplier's name and address.

5. Manufacturer's maintenance manuals for each item of equipment furnished under this contract. Manuals shall include such items as parts list, detailed lubrication instructions, procedures for performing normal maintenance functions, preliminary trouble shooting procedures and wiring diagrams.
  6. Complete wiring diagrams for the plumbing systems as actually wired including control and interlock wiring.
  7. Brief but complete instructions for start-up, shut- down and routine maintenance of each system.
  8. Routine and 24-hour emergency information:
    - a. Name, address and telephone number of servicing agency.
    - b. Include names of personnel to be contacted for service arrangements.
- C. Frame one (1) copy of brief start-up, shut-down and routine maintenance instructions and complete system wiring diagrams under glass and mount on the Equipment Room wall.

#### 1.07 RECORD DOCUMENTS

- A. The Contractor shall keep an accurate record of all deviations from Contract Drawings and Specifications. He shall neatly and correctly enter in colored pencil any deviations on Drawings affected and shall keep the Drawings available for inspection. Extra sets of Drawings will be furnished for this purpose.
- B. At the completion of project and before final approval, make any final corrections to Drawings and certify to the accuracy of each print by signature and deliver same to Architect

#### 1.08 SUPERVISION

- A. This Contractor shall have in charge of the work, on the job during construction, a competent superintendent experienced in the work installed under this Contract.

#### 1.09 UNACCEPTABLE WORK AND OBSERVATION REPORTS

- A. Work shall be unacceptable when found to be defective or contrary to the Plans, Specifications, Codes specified or accepted standards of good workmanship.
- B. The Contractor shall promptly correct all work found unacceptable by the Architect and/or Construction Manager or the Owner whether observed before or after substantial completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such unacceptable work, including compensation for the Architect's or the Construction Manager's additional services made necessary thereby.

- C. During the course of construction, the Architect will prepare "Observation Reports" with a list of items found to be in need of correction. All items listed shall be corrected by the Contractor. A space is provided on the form for the Contractor to note the completion of each item. All prior "Observation Report" items must be completed, the lists signed and returned to the Architect prior to making the final inspection. After the final list is issued, the same procedure will apply.

#### 1.10 FINAL INSPECTION

- A. When the Contractor determines all work is completed and working properly per the Contract Documents, he shall request a "final" inspection by the Architect in writing. If more than one reinspection is required after this final inspection, the Contractor shall bear all additional costs including compensation for the Architect's additional services made necessary thereby.
- B. As part of the final checkout of the project, the Architect will be checking out the operation of the various systems. This Contractor shall provide such assistance as required (including manpower and tools) to start and stop the various systems, open and close valves etc. The Contractor (not the Architect) is responsible to turn on the systems and demonstrate they are operating properly.

#### 1.11 GUARANTEE

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year after final payment is approved by the Architect.

### **PART 2 PRODUCTS**

Not Applicable.

### **PART 3 EXECUTION**

Not Applicable.

**END OF SECTION**

## **SECTION 22 05 00 - 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. Equipment installation requirements common to equipment sections.
  9. Painting and finishing.
  10. Concrete bases.
  11. 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.
- F. The following are industry abbreviations for plastic materials:
  1. ABS: Acrylonitrile-butadiene-styrene plastic.
  2. CPVC: Chlorinated polyvinyl chloride plastic.
  3. PE: Polyethylene plastic.
  4. PVC: Polyvinyl chloride plastic.



- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.

- B. Welding certificates.

#### 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 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. 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 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. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:

1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  4. Aboveground Pressure Piping: Pipe fitting.
- B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
  1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epcos Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.

- c. Epco Sales, Inc.
  - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F .
- 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
- 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Metraflex Co.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Sealing Elements: EPDM 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.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## 2.8 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
  - 1. Finish: Polished chrome-plated.
- C. 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 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction

loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - b. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - d. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
    - e. 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. PVC Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 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. 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.
- ### 3.3 PIPING JOINT CONSTRUCTION
- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- 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. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

### 3.4 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.



### 3.5 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 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.

### 3.6 PAINTING

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### 3.7 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified.

### 3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### 3.9 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing 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.

### 3.10 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 on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION**



## **SECTION 22 05 16 - SLEEVES AND COLLARS**

### **PART 1 GENERAL**

#### 1.01 REFERENCE

- A. Section 22 05 21 - CUTTING AND PATCHING

#### 1.02 SCOPE

- A. This Contractor shall furnish and install all sleeves for his work. Coordinate carefully with the General Contractor.
- B. Sleeves shall be provided through all new masonry construction. Sleeves are not required if holes are core drilled through existing walls.

### **PART 2 PRODUCTS**

- 2.01 Sleeve material: black steel pipe, machine cut, large enough to allow 1/4" clearance all around pipe (around pipe covering on chilled water and cold water).

### **PART 3 EXECUTION**

- 3.01 Sleeves in partitions to have length equal to the thickness of finished partitions. Sleeves in floors of finished areas to project 1/8" above finished floor. Sleeves in floors of non-finished areas to project 3" above finished floor. Fill space between pipe and sleeves into exposed areas with sealing compound. Ream all sleeves before installing.
- 3.02 Where pipes pass through fire rated walls or floors, the space between the pipe and sleeve shall be filled with packing to maintain fire integrity.
- 3.03 Sleeves to be set in forms before concrete is poured and in partitions at the time same are being built.
- 3.04 In exposed location, other than in Mechanical Equipment Rooms, bare pipe or insulated pipe shall be provided with chromium plated collars at floor, ceiling, and at partitions.
- 3.05 Cutting required of any masonry wall or floor after it is in place shall be done by core drilling.
- 3.06 Piping not allowed to bear on sleeves.
- 3.07 Sleeves shall be installed plumb and true to line, grade, and position.
- 3.08 Unused sleeves shall be plugged and finished to match adjacent surface.

### **END OF SECTION**



## SECTION 22 05 17 - FIRESTOPPING

### PART 1 GENERAL

#### 1.01 SCOPE

- A. Each Contractor shall be responsible for firestopping around all openings for pipes, ducts, conduits, etc., installed by him at all fire walls and smoke walls. Firestopping shall be performed by an installer who has been trained by manufacturer, or manufacturer's representative, in the installation procedures based on published UL tested fire stop systems.

#### 1.02 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

#### 1.03 REFERENCE

- A. Division 1 – General Conditions
- B. Division 3 – Concrete
- C. Division 4 – Masonry
- D. Division 9 – Finishes
- E. Section 22 05 16 – Sleeves and Collars

#### 1.04 GENERAL REQUIREMENTS

- A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Through-Penetration Firestop Devices (XHCR)
    - b. Fire Resistance Ratings (BXUV)
    - c. Through-Penetration Firestop Systems (XHEZ)
    - d. Fill, Voids, or Cavity Material (XHHW)
    - e. Forming Materials (XHKU)
- C. International Firestop Council Guidelines for Evaluating Firestop Systems Associating Judgments

- D. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. The Ohio Building Code (OBC)
- F. NFPA 101 - Life Safety Code

#### 1.05 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.
- B. Firestop System installation must meet requirements of ASTM E-814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineer judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

#### 1.06 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Manufacturer's engineering judgment identification number and drawing details when no UL system is available for an application. Engineer judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- C. Submit material safety data sheets provided with product delivered to job-site.

#### 1.07 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell

its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

#### 1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

#### 1.09 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
  - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
  - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

### **PART 2 PRODUCTS**

#### 2.01 FIRESTOPPING, GENERAL

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under



conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.

- B. Provide components for each firestopping system that is needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

## 2.02 ACCEPTABLE MANUFACTURERS

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:

1. Hilti, Inc., Tulsa, Oklahoma, (800)879-8000
2. Tremco Sealants & Coatings, Beachwood, Ohio, (216) 292-5000
3. 3M Fire Protection Products, St. Paul, Minnesota, (612) 736-0203

## 2.03 MATERIALS

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.

- B. Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:

1. Hilti CP 680 Cast-In Place Firestop Device
2. Fox Coupling, Inc. "Cast-In-Place Firestop Coupling".
3. Proset Cast-In-Place Device

- C. Sealant or caulking materials for use with non-combustible items including steel pipe & copper pipe, the following products are acceptable:

1. Hilti FS-ONE Intumescent Firestop Sealant
2. 3M Fire Barrier CP25 or Firestop Sealant 2000
3. Tremco Fyre Shield

- D. Sealant or caulking materials for use with sheet metal ducts, the following products are acceptable:

1. Hilti CP 601S Elastomeric Firestop Sealant or CP 606 Flexible Firestop Sealant
2. Tremco Fyre-Shield High Performance Ceramic Firestop Sealant
3. 3M Fire Barrier CP25WB+ or 2000 Silicone Sealant

- E. Intumescent sealant or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe and plastic pipe, the following products are acceptable:
1. Hilti FS-ONE Intumescent Firestop Sealant
  2. 3M Fire Barrier CP25WB+
  3. Tremco Intumescent Acrylic or TremStop WBM
- F. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
1. Hilti CP 642 and CP643 Firestop Collar, CP645 Wrap Strip
  2. Tremco TREMstop D Combustible Pipe Intumescent Device System and TremStop WS Wrap Strip
  3. 3M Ultra Plastic Pipe Device and Fire Barrier FS-195+ Wrap Strip
- G. Materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
1. Hilti FS 635 Trowelable Firestop Compound and FS 657 FIRE BLOCK
  2. Tremco TremStop M Fire Rated Mortar and PS Pillows
  3. 3M Fire Barrier CS-195+ Composite Sheet
- H. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
1. Hilti FS 657 FIRE BLOCK
  2. Tremco PS Firestop Pillows
  3. 3M CS Intumescent Sheet
- I. Provide a firestop system with an "F" Rating as determined by UL 1479 or ASTM E814. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated.

## **PART 3 EXECUTION**

### **3.01 PREPARATION**

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - 5. Do not proceed until unsatisfactory conditions have been corrected.

### **3.02 COORDINATION**

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

### **3.03 INSTALLATION**

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
  - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
  - 2. Consult with the Owner' Representative and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
  - 3. Protect materials from damage on surfaces subjected to traffic.

3.04 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas. All penetrations are to be labeled in accordance with the Architect's standard labeling system. The HVAC Contractor shall coordinate all fire stopping requirements with the Architect/Construction Manager prior to start of work.
- B. Keep areas of work accessible until inspection and approval have been completed.
- C. All fire stopping shall be inspected and approved by a licensed independent Consultant. All unapproved fire stopping products installed by this contractor will be removed and replaced at his expense.
- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.05 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

**END OF SECTION**

## SECTION 22 05 23

### 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 ball valves.
  - 2. Iron, single-flange butterfly valves.
  - 3. Iron, grooved-end butterfly valves.
  - 4. Bronze swing check 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 B31.1 for power piping valves.
  - 3. ASME B31.9 for building services piping valves.
- C. NSF Compliance: NSF 61 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 ball valves open to minimize exposure of functional surfaces.
  - 4. Set butterfly valves closed or slightly open.
  - 5. Block check valves in either closed or open position.
- 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.

## **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 indicated and as required for system pressures and temperatures.
- C. Valve Sizes: Same as upstream piping unless otherwise indicated.
- D. Valve Actuator Types:
  - 1. Handwheel: For valves other than quarter-turn types.
  - 2. Handlever: For quarter-turn valves NPS 6 and smaller.
- E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
  - 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
  - 2. Butterfly Valves: With extended neck.
- F. Valve-End Connections:
  - 1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Grooved: With grooves according to AWWA C606.
3. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

## 2.2 BRONZE BALL VALVES

- A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-110.
    - b. SWP Rating: 150 psig.
    - c. CWP Rating: 600 psig.
    - d. Body Design: Two piece.
    - e. Body Material: Bronze.
    - f. Ends: Threaded.
    - g. Seats: PTFE or TFE.
    - h. Stem: Bronze.
    - i. Ball: Chrome-plated brass.
    - j. Port: Full.

## 2.3 IRON, SINGLE-FLANGE BUTTERFLY VALVES

- A. 200 CWP, Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Crane Co.; Crane Valve Group; Crane Valves.
    - b. Hammond Valve.
    - c. Milwaukee Valve Company.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  2. Description:
    - a. Standard: MSS SP-67, Type I.
    - b. CWP Rating: 200 psig.
    - c. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
    - d. Body Material: ASTM A 126, cast iron.
    - e. Seat: EPDM.
    - f. Stem: One-piece stainless steel.
    - g. Disc: Aluminum bronze.

## 2.4 BRONZE SWING CHECK VALVES

- A. Class 125, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.; Crane Valve Group; Crane Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. Powell Valves.
  - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. 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.

### **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 check valves for proper direction of flow and as follows:
  1. Swing Check Valves: In horizontal position with hinge pin level.



### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball or butterfly valves.
  - 2. Throttling Service: Ball valves.
  - 3. Pump-Discharge Check Valves:
    - a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
- B. 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.
  - 2. For Copper Tubing, **NPS 2-1/2 to NPS 4**: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

- A. Pipe NPS 2-1/2 and Smaller:
  - 1. Ball Valves: Two piece or three piece, full port, bronze with stainless-steel trim.
  - 2. Bronze Swing Check Valves: Class 150, bronze disc.
- B. Pipe NPS 3 and Larger:
  - 1. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM seat, aluminum-bronze disc.
  - 2. Bronze Swing Check Valves: Class 150; single plate; resilient seat.

**END OF SECTION**

## SECTION 22 05 29

### HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

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

##### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Metal framing systems.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Equipment supports.
- B. Related Sections:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

##### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

##### 1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
  - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

##### 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
  - 1. Metal framing systems.

2. Pipe stands.
3. Equipment supports.

C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- B. Stainless-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  3. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
- C. Copper Pipe Hangers:
  1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
  2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

### 2.2 METAL FRAMING SYSTEMS

- A. MFMA Manufacturer Metal Framing Systems:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.
    - c. Flex-Strut Inc.
    - d. GS Metals Corp.
    - e. Thomas & Betts Corporation.
    - f. Unistrut Corporation; Tyco International, Ltd.
    - g. Wesanco, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of stainless steel.
7. Metallic Coating: Electroplated zinc.
8. Paint Coating: Epoxy.

## 2.3 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength and vapor barrier.
- C. Insulation-Insert Material for Hot Piping: ASTM C 552, Type II cellular glass with 100-psig minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

## 2.4 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

## 2.5 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

## 2.6 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. See Division 22 plumbing fixture Sections for requirements for pipe positioning systems for plumbing fixtures.

- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- I. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Install lateral bracing with pipe hangers and supports to prevent swaying.
- K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- L. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- N. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
  - 5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 EQUIPMENT SUPPORTS

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### 3.3 METAL FABRICATIONS

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:
  - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  - 2. Obtain fusion without undercut or overlap.
  - 3. Remove welding flux immediately.
  - 4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

### 3.4 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### 3.5 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.6 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and metal framing systems and attachments for general service applications.
- F. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. 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.
  - 5. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 6. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 7. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
  - 8. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
  - 9. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
  - 10. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
- J. 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.



- K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. 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. 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.
  10. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  11. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  12. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- L. 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.
- M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- N. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- O. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- P. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

**END OF SECTION**

## **SECTION 22 05 30 - INSTALLATION OF PIPING**

### **PART 1 GENERAL**

#### 1.01 REFERENCE

- A. Section 22 05 19 - METERS AND GAUGES
- B. Section 22 05 23 - GENERAL DUTY VALVES
- C. Section 22 05 29 - INSERTS, PIPE HANGERS AND SUPPORTS
- D. Section 22 05 93 - TESTS AND ADJUSTMENTS

#### 1.02 SCOPE

- A. The requirements of this Section shall apply to all interior piping systems installed under this Contract, except where otherwise noted on the Drawings or elsewhere in the Specifications.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.01 All piping systems shall be installed with adequate provisions made for expansion and contraction to prevent stresses on piping, valves and equipment. Anchor and guide piping at all points indicated and/or as required. Type and method of anchoring, guiding and attachments to sustaining members to suit job requirements and conditions and shall be approved by the Architect.
- 3.02 Provide unions or flanges at each final connection, and at each piece of equipment. Branches from mains to equipment stubs, risers, etc., to have swing joints with at least one change of direction in the horizontal plane, and one change of direction in the vertical plane, before connecting to equipment or fixtures. Piping shall be arranged and unions and flanges located to permit easy removal of parts and equipment for inspection and cleaning without disconnecting any part except unions or flanges. No welded connections shall be made to valves or equipment. Use bronze unions in copper lines. Unions to be downstream of valves.
- 3.03 Flange bolts shall be cut to proper length so that one thread projects beyond the nut when nut and bolt are tightened.
- 3.04 Make proper connections to all items of equipment in the Contract as recommended by the Manufacturer or as detailed on the Drawings.
- 3.05 All piping shall be arranged in accordance with the best standards of the trade with vertical pipes plumb and horizontal runs parallel or perpendicular to the building wall.
- 3.06 Provide valves and specialties where indicated on the Drawings.

- 3.07 Provide 3/4" drain valves in piping at low points to provide complete drainage of all systems and as shown on the Drawings.
- 3.08 Ream ends of pipe and clean before installing.
- 3.09 All joints in copper piping shall be made with 95-5 solder. Solders and fluxes containing lead are prohibited.
- 3.10 Use pipe dope on male threads of screwed pipe only. Teflon pipe joint tape may be used, at the Contractor's option.
- 3.11 Valves to be installed with handwheel at or above center of pipe. Valves outdoors exposed to weather shall be installed with handwheel in the horizontal.
- 3.12 Make all changes of direction with fittings, rather than bending.
- 3.13 All valves and unions to be installed so as to be accessible through ceiling, access panels, etc.
- 3.14 Provide dielectric unions or insulating flanges between dissimilar metals, i.e., copper to steel.
- 3.15 Bull head connections in any piping service are expressly prohibited.
- 3.16 At the end of each day's work and otherwise as required or directed, provide caps and/or plugs at all openings in piping for protection. Particular attention must be given to avoid the possibility of any foreign materials entering the pipes, whether it be inadvertent or with malicious intent.
- 3.17 Flanged joints shall be faced true and square. Flanges shall be same face style as mating surface to which it is connected.
- 3.18 Install thermometers and gauges so they may be read from floor level.
- 3.19 Install Pete's Plugs as close as possible to control valves, coils, etc., as shown on the Drawings, and arranged so that a probe may be inserted into the plug.
- 3.20 Where piping is installed in accessible chases, keep all piping to sides of chase, except portions which must necessarily be in center of chase. Offset vents to side immediately above connection to waste line. All lateral runs are to be located at the floor or minimum 6'-0" above floor, and all vertical piping held close to the wall through that height leaving maximum service space.
- 3.21 Where pipe drops occur in block walls, pipes to enter and leave walls at block joints. Coordinate with General Contractor.
- 3.22 Install galvanized sheet metal troughs with drains under pipes crossing electrical equipment. Seal to make water tight.
- 3.23 Do not run water or steam piping through electrical rooms.

- 3.24 Properly support all relief valve discharge piping and provide no more than one 90° ell.
- 3.25 Install galvanized steel pan under all water heaters on floors above the First Floor. Route drains properly.

**END OF SECTION**

## **SECTION 22 05 53 - 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. Valve tags.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.
- C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- D. Valve numbering scheme.
- E. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

### **PART 2 - PRODUCTS**

#### 2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 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.
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-inch for name of units if viewing distance is less than 24 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel 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 cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  2. Lettering Size: At least 1-1/2 inches high.

## 2.3 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: Aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  2. Fasteners: Brass wire-link chain.
- 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 framed and mounted on the wall in the central mechanical rooms. An additional copy 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. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
  - 1. Near each valve and control device.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. 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: Purple.
    - 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: 2 inches, round.
  - b. Hot Water: 2 inches round.
2. Valve-Tag Color:
  - a. Cold Water: Green.
  - b. Hot Water: Yellow.
  - c. Hot Water Return: Orange.
3. Letter Color:
  - a. Cold Water: White.
  - b. Hot Water: White.

### 3.5 WARNING-TAG INSTALLATION

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

**END OF SECTION**



## SECTION 22 05 93 - TESTS AND ADJUSTMENTS

### PART 1 GENERAL

#### 1.01 SCOPE

- A. After work has been completed but before pipe covering has been applied, the Contractor shall test and adjust the systems he has installed.
- B. The Architect shall be notified of all scheduled tests and adjustments at least 48 hours before they are scheduled so that he may witness same. If the Contractor performs any test or adjustment without the Architect present or without properly notifying the Architect the Contractor will be required to perform the test or adjustment a second time in the presence of the Architect.
- C. If the Architect determines that any work requires special inspection, testing, or approval, he will, upon written authorization from the Owner, instruct the Contractor to order such special inspection, testing or approval. The Contractor shall give timely notice so the Architect may observe the inspections, tests or approvals. If such special inspection or testing reveals a failure of the work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the Architect's additional services made necessary by such failure; otherwise the Owner shall bear such costs, and an appropriate Change Order shall be issued.
- D. Concealed lines shall be tested before being concealed. If this is not done and a leak appears during the final test, this Contractor shall repair leak and all damage resulting therefrom.
- E. This Contractor shall adjust all his equipment in the mechanical system to obtain proper operation and shall demonstrate to the Owner and Architect that the entire system will function properly.

### PART 2 PRODUCTS

Not Applicable

### PART 3 EXECUTION

#### 3.01 TESTS

- A. After work has been completed but before pipe covering has been applied, the Contractor shall test the systems as follows. At these pressures, the circulation shall be free and the piping free of leaks.

System	Test Medium	Pressure Not Less Than	Time Not Less Than	Notes
<hr/>				

Water lines	water	125 lbs	6 hrs	no drop
Gas	air	50 lbs	24 hrs	no drop
Drainage systems	In accordance with applicable plumbing codes			

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- 3.02 Purge gas system to outdoors. Purge and test to be witnessed by Gas Company and Architect.
- 3.03 The Contractor, before starting any pumping unit with pump and driver mounted on a common base plate with a flexible couplings, shall check the unit for proper alignment.
- 3.04 Before turning job over to Owner, inspect all valves and repack valves as necessary.
- 3.05 This Contractor shall adjust all equipment in the mechanical system to obtain proper operation and shall demonstrate to the Owner and Engineer that the entire system will function properly.

**END OF SECTION**

## **SECTION 22 05 94 - PROTECTION AND CLEANING**

### **PART 1 GENERAL**

Not Applicable

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.01 Protect all mechanical equipment against damage from any cause whatsoever and pay the cost of replacing and repairing equipment made necessary by failure to provide suitable protection.
- 3.02 After all piping and equipment has been approved and after all plastering has been completed, bare piping and insulation provided under this Contract shall be thoroughly cleaned of dirt, grease, rust and oil.
- 3.03 Repair all dents and scratches in factory prime or finish coats on all mechanical equipment to the satisfaction of Associate. If damage is excessive, replacement may be required.
- 3.04 Flush out all piping systems to remove all dirt and grease from pipes and equipment before systems are placed in operation.
- 3.05 Cover all pumps, open pipes, etc., to keep out dirt, water and weather during construction.
- 3.06 This Contractor shall clean up and remove all debris from the site and shall at all times keep the premises in a neat and orderly condition.

### **END OF SECTION**

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JANUARY 9, 2024  
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## **SECTION 22 05 95 - FLUSHING AND STERILIZATION**

### **PART 1 GENERAL**

#### **1.01 SCOPE**

- A. Flush out all domestic water piping systems to remove all dirt and grease from pipes and equipment before systems are placed into operation. Clean strainers after each flushing until the strainer remains clean.
- B. After domestic water lines are all installed, sterilize lines, including outside services as prescribed by AWWA-C-651. Sterilization shall be done under the immediate on the job supervision of a water testing laboratory regularly engaged in the service and shall be done per their instructions. All fees for testing and test equipment shall be paid by this Contractor.
- C. Furnish a Certificate of Sterilization and Approval For Human Consumption signed by a Professional Engineer registered in the State of Ohio regularly in the employ of the Testing Laboratory. Certification shall be furnished to the Associate and University before payment will be made.

### **PART 2 PRODUCTS**

- 2.01 Sterilization: Chlorinating material either liquid chlorine meeting AWWA Standard B301, sodium or calcium hypochlorite meeting AWWA Standard B300.

### **PART 3 EXECUTION**

- 3.01 With all outlets closed, fill system to working pressure and close valve at supply main.
- 3.02 A cleaning solution containing not less than 150 parts per million of chlorine shall be introduced into the system.
- 3.03 Each outlet, hot and/or cold, shall be tested during fill to prove the presence of chlorine at that outlet and valves and faucets shall be opened and closed several times during the disinfecting time period.
- 3.04 Water piping systems shall remain filled for a period of 24 hours and each outlet shall be again tested and shall produce not less than 100 parts per million of chlorine at the end of the retention period.
- 3.05 All outlets shall be opened wide and the main supply valves opened, flushing system with water until chlorine content is not greater than 0.2 parts per million or until approved by the Health Department. Flush drain valves.
- 3.06 After final flushing all aerators on plumbing brass shall be removed, cleaned and reinstalled.

3.07 Sterilization test may be performed at the same time the pressure test is placed on the system.

**END OF SECTION**

## SECTION 22 06 00 - MANUFACTURER'S DRAWINGS

### PART 1 GENERAL

#### 1.01 SCOPE

- A. The Contractor shall submit for review six (6) copies of fire protection equipment submittals, hydraulic calculations and sprinkler layout drawings, etc as noted below in three distinct sequential stages:
1. **Materials and Equipment List:** Include all materials, equipment, and accessories required for work. Include catalog ID numbers, drawings, cut sheets as necessary to define the work. If cut sheets include multiple selections, and or optional selections, then clearly label the included sections and the included options. Submit to the Architect for review.
  2. **Preliminary Shop Drawings:** Include sprinkler head locations only. Include full-size detail representation of each style of sprinkler head to be used. Submit to the Architect for review.
  3. **Detailed Shop Drawings:** Include pipe layout and sizing, sprinkler head locations coordinated onto reflected ceiling drawings, hydraulic calculations, system controls, and all equipment cut sheets, zone valves, zone drain valves, and zone test stations. Submit to all required parties, Architect, Authority Having Jurisdiction (AHJ), the local Fire Chief, State Fire Marshal, and the Owner's Insurance Underwriter, for review and approval by all.
- B. The Architect will review Contractor's shop drawings and related submittals (as indicated above and below) with respect to the ability of the detailed work, when complete, to be a properly functioning integral element of the overall system designed by the Architect. Before submitting a shop drawing or any related material to the Architect, Contractor shall: review each such submission for conformance with the means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto, all of which are the sole responsibility of Contractor; approve each such submission before submitting it; and so stamp each such submission before submitting it. The Architect shall assume that no shop drawing or related submittal comprises a variation unless Contractor advises Architect otherwise via a written instrument which is acknowledged by Architect in writing. The shop drawings and related material (if any) called for are indicated below:

#### Plumbing Contract

Backflow Preventers  
Pressure Reducing/Control Valves  
Gas Fired Instantaneous Domestic Water Heaters  
Master Mixing Valves  
Point-of-Use Mixing Valves

Recirculation Pumps  
Plumbing Fixtures  
Lint Interceptors  
Drains and cleanouts  
Elevator Sump Pump  
Piping and valves  
Firestopping  
Trap Primers

- C. The Architect shall return shop drawings and related materials with comments provided that each submission has been called for and is stamped by Contractor as indicated above. The Architect shall return without comment material not called for or which has not been approved by Contractor.
- D. This Contractor shall furnish equipment shop drawings which will indicate power hook up and control connections as required for mechanical equipment. "Stock" wiring diagrams are NOT ACCEPTABLE.
- ~~E. The HVAC Contractor is to provide sepias of sheet metal drawings for use in coordinating work of Plumbing, Fire Protection and Electrical with layout of air distributions system and related work. Lighting, ceiling grid and ceiling access doors will be shown lightly to verify coordination. HVAC Contractor to provide initial sepias within 60 days of award of contract. Each Prime Contractor is responsible for overlaying his work onto these sepias; for providing information as to size, elevation and location proposed for all components; and for coordination of his work with that of other Contractors. Final resolution of all items to be determined at project meetings held by Lead Contractor.~~
- F. Architect's review of manufacturer's drawings or schedules shall not relieve the Contractor from compliance with the requirements of the plans and specifications.

## 1.02 QUANTITIES

- A. Items may be referred to in singular or plural on Plans and Specifications. Contractor is responsible for determining quantity of each item.

## PART 2 PRODUCTS

Not Applicable

## PART 3 EXECUTION

Not Applicable

**END OF SECTION**



## SECTION 22 07 19 - PLUMBING PIPING INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes insulating the following plumbing piping services:
  1. Domestic cold-water piping.
  2. Domestic hot-water piping.
  3. Domestic recirculating hot-water piping.
  4. Domestic tempered water piping.
  5. Heat recovery piping.
  6. Drains receiving low temperature condensate drain discharge.
  7. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Qualification Data: For qualified Installer.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- D. Field quality-control reports.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

- C. Comply with the following applicable standards and other requirements specified for miscellaneous components:
  - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 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 "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Aeroflex USA, Inc.; Aerocel.
- b. Armacell LLC; AP Armaflex.
- c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

G. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Johns Manville; Micro-Lok.
  - b. Knauf Insulation; 1000-Degree Pipe Insulation.
  - c. Manson Insulation Inc.; Alley-K.
  - d. Owens Corning; Fiberglas Pipe Insulation.
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. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

2.2 INSULATING CEMENTS

A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Ramco Insulation, Inc.; Super-Stik.
  - b. Or Approved equal.

B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Aeroflex USA, Inc.; Aeroseal.
  - b. Armacell LLC; Armaflex 520 Adhesive.
  - c. K-Flex USA; R-373 Contact Adhesive.
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. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
  - b. Eagle Bridges - Marathon Industries; 225.
  - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
  - d. Mon-Eco Industries, Inc.; 22-25.
2. For indoor applications, 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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
  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. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  2. For indoor applications, 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-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F.
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.

## 2.5 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.

## 2.6 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  - 2. Adhesive: As recommended by jacket material manufacturer.
  - 3. Color: Color-code jackets based on system.
  - 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.

## 2.7 TAPES

- A. ASJ+ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  - 2. Width: 3 inches.
  - 3. Thickness: 11.5 mils.
  - 4. Adhesion: 90 ounces force/inch in width.
  - 5. Elongation: 2 percent.
  - 6. Tensile Strength: 40 lbf/inch in width.
  - 7. ASJ+ Tape Disks and Squares: Precut disks or squares of ASJ+ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  - 2. Width: 2 inches.
  - 3. Thickness: 6 mils.
  - 4. Adhesion: 64 ounces force/inch in width.
  - 5. Elongation: 500 percent.
  - 6. Tensile Strength: 18 lbf/inch in width.
- C. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
  - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. ABI, Ideal Tape Division; 488 AWF.
- b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
- c. Compac Corporation; 120.
- d. Venture Tape; 3520 CW.
2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

## 2.8 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Engineered Brass Company.
    - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    - c. McGuire Manufacturing.
    - d. Plumberex.
    - e. Truebro; a brand of IPS Corporation.
    - f. 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.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
  1. Verify that systems to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### 3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-in wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inch o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
    - a. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  - 1. Seal penetrations with flashing sealant.
  - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.



1. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and

- unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

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 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.8 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. 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.

### 3.9 FINISHES

- A. Insulation with ASJ+, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
  1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### 3.10 FIELD QUALITY CONTROL

- A. Testing Agency: Owner may engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.

- C. Tests and Inspections:
  - 1. 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.
- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- 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.

### 3.12 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water and drains receiving low temperature condensate drain discharge:
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
- B. Domestic Hot, Domestic Tempered, Recirculated Domestic Hot Water, and Heat Recovery Piping:
  - 1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
  - 2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 1 inch thick.
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

**END OF SECTION**

SECTION 22 11 16 - DOMESTIC WATER PIPING SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. Provide a complete domestic water supply & return piping system as shown on plans and as necessary to serve all items/elements requiring same.
- B. The domestic water piping system shall include, but not be limited to the following:
  - 1. Cold water supply
  - 2. Hot water supply
  - 3. Hot water return
  - 4. Tempered water supply (full temperature range)
  - 5. Trap primer supply
  - 6. Domestic water make-up supply to elements provided under separate contract, such as HVAC equipment/systems, ponds/pools, irrigation systems, etc.
  - 7. Softened/treated water supply
  - 8. Non-potable water supply
- C. All elements specified herein and/or indicated on plans with components/parts in contact with the potable water medium shall be listed for such service, in accordance with referenced code requirements.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

\*NO SWEAT/SOLDER VALVES OR DIELECTRIC UNIONS PERMITTED ON PROJECT\*

\*NO COMPRESSION FITTINGS PERMITTED ON PROJECT; SOLDERED JOINT CONNECTIONS ONLY. PIPE DIAMETERS ABOVE 2" SHALL BE BRAZED\*

\*NO GROOVED JOINT PIPING PERMITTED\*

- A. Above ground piping up to and including 6" size:
  - 1. Type L hard drawn copper tube with wrought copper fittings and socket solder joints and connections. 2 1/2" & larger size joints & fittings to be brazed. Tee drill mechanical saddle connections may be utilized for branch take-offs, provided they are listed/approved extruded type, in compliance with the requirements of all review, inspection and approval authorities, confirmed by the Plumbing Contractor in advance. Completed installation to be rated for 125 psig working pressure.
  - 2. Where the shut-off discharge pressure from a booster pump plus the incoming water supply suction pressure exceeds 125 psig, the following piping type shall be used:

- a. Type K hard drawn copper tube with roll grooved gasketed mechanical couplings similar to Victaulic style 607, rated for 300 psig working pressure.
  - b. This shall apply to piping to the inlet of pressure reducing/regulating assemblies set to maintain outlet pressure at 125 psig or less, or to a point where hydraulic calculations prove that the system pressure will not exceed 125 psig under any circumstances.
- B. Piping in electro-magnetic equipment areas to be non-ferrous type L hard wrot copper with wrot copper pressure fittings. Connections to be socket brazed or listed mechanical coupling type with neoprene gaskets. Installation to be rated for 125 psig working pressure. Extent of electro-magnetic field area to be confirmed from architectural & equipment installation plans in advance.
- C. Below ground piping 2" diameter and smaller to be listed/approved type K soft copper tubing in a single length with no in-line couplings or joints, and a minimum number of fittings (required by branch take-offs, if any) unless indicated otherwise. Fittings (if required) to be wrot copper with socket solder brazed connections. Completed installation to be rated for 175 psig working pressure. All piping 1" diameter size and smaller below slab on grade to be installed in a schedule 40 PVC 3" diameter conduit. Install conduit from 2" above slab at entry/exit points, and use long sweep elbows for vertical rise/drop from/to below slab. Unless indicated otherwise, horizontal piping and conduit below slab to run in a straight line direct from entry to exit points. Where copper piping is direct buried, provide listed protective wrap at floor structure penetrations.
- D. Solder, flux and all other pipe joining materials shall be certified "lead free" and listed for use with potable water service.

## 2.02 SHOCK ABSORBERS

- A. Similar to Zurn Shocktrol series Z-1700, sized and installed as recommended by the manufacturer for specific conditions at each location.
- B. Equal shock absorbers as manufactured by Zurn, Mifab, J.R. Smith, Josam, Sioux Chief or Precision Plumbing Products may be provided at the contractor's option.

## 2.03 HOSE BIBBS; as specified on plans, unless indicated otherwise.

- A. Equal hose bibbs as manufactured by Zurn, Mifab, J.R. Smith, Josam, Wade, Watts, Woodford or Murdock may be furnished at the contractor's option.

## 2.04 TRAP PRIMER ASSEMBLIES; as specified on plans, unless indicated otherwise.

- A. Equal trap primer assemblies as manufactured by Zurn, J.R. Smith, Josam, Precision Plumbing Products, Wade, Sloan, Mifab or Sioux Chief may be furnished at the contractor's option.

## 2.05 TEMPERING/MIXING VALVE ASSEMBLIES

- A. Low flow capacity or individual fixture/equipment service shall be thermostatic mixer assembly similar to Leonard 210 series with inlet check/stops, bi-metal thermostat, bronze construction, screwdriver adjustable temperature setting, and 1/2" threaded connections rated for 125 psig working pressure.

- B. High flow capacity or multiple simultaneous use fixtures/equipment service shall be thermostatic mixer assembly similar to Leonard TM series with inlet check/stops, bi-metal thermostat, bronze construction, lever adjustable temperature setting, and threaded connections rated for 125 psig working pressure.
- C. Broad flow range (minimum/maximum) and/or multiple non-simultaneous use fixtures/equipment service shall be thermostatic mixer assembly similar to Lawler 86000 series with isolation/service valves, pressure gauges, thermometer, and inlet/outlet union connections rated for 125 psig working pressure. Furnish with lockable cabinet enclosure for surface mounting on wall when indicated on plans; furnish with painted pressure treated 1/2" thickness plywood backboard for exposed installation if no cabinet is indicated.
- D. Assemblies shall be furnished with adjustable position inlets and outlet, incoming temperature range of 120 to 180 degrees F., and nominal pressure differential of 10 psig unless indicated otherwise. Flow capacities, outlet temperature setting and inlet/outlet temperature differential as indicated on plan. Provide assemblies as required to operate properly with temperature differential as indicated.
- C. Tempering valves as specified herein may be used for supply to emergency/safety fixtures, provided they are listed by the manufacturer for such service. Tempering valves in this application shall include a cold water bypass feature.
- D. Equal tempering/mixing valve assemblies as manufactured by Leonard, Watts, Bradley, Zurn, Powers, Lawler, T & S or Symmons may be furnished at the contractor's option.

2.06 PRESSURE REDUCING/REGULATING VALVES

- A. Low flow (0.5 to 20 gpm) capacity and/or individual fixture/equipment service shall be direct acting diaphragm type bronze construction pressure reducing valve similar to Watts model no. U5LP with integral inlet strainer, outlet pressure gauge, internal thermal expansion bypass, adjustable outlet pressure range and threaded connections rated for 175 psig working pressure. Valve to be rated for maximum 180 degrees F. temperature service. Assembly to be listed in accordance with ASSE 1003 standards.
- B. Moderate flow range (1 gpm minimum/120 gpm maximum) diversified load service shall be direct acting diaphragm type bronze construction pressure reducing valve similar to Watts model no. 223 with adjustable outlet pressure range and threaded or flanged connections rated for 175 psig working pressure.
- C. Broad flow range (1 gpm minimum/1800 gpm maximum) diversified load service shall be hydraulically operated pilot controlled diaphragm type iron body valve similar to Cla-Val Co. 90-48 series with bronze fittings, integral low flow by-pass, adjustable outlet pressure range and threaded or flanged connections rated for 175 psig working pressure.
- D. Assemblies shall be furnished with adjustable position inlets and outlet. Flow capacities, outlet pressure setting and inlet/outlet pressure differential as indicated on plan. Provide assemblies as required to operate properly with pressure differential as indicated.
- E. Assemblies shall be listed for potable water service including certified "lead-free" construction.



- F. Equal pressure reducing/regulating valve assemblies as manufactured by Watts, Cla-Val Co., Wilkins, Febco, Ames, Anderson, Watrous or Conbraco may be furnished at the contractor's option.

2.07 OVERHEAD COLD WATER HOSE REELS; as specified on plans.

- A. Equal hose reel assemblies as manufactured by Reelcraft, Hannay, McMaster, Carr, Coxreel, Chicago Faucet, Water Saver or Speakman may be furnished at the contractor's option.

2.08 BACKFLOW PREVENTORS

- A. Reduced pressure principle backflow preventers shall be similar to Wilkins model no. 575 RP Series with ASSE 1013 listing, test cocks, pressure differential relief valve, positive seat check valves, fixed air gap drain/vent fitting & tight-closing shut-off valves before and after the device. Furnish with threaded connections for sizes 2" and smaller, 150 class flange connections for sizes 2-1/2" and larger.
- B. Dual check backflow preventor assemblies shall be similar to Watts model no. 7 with ASSE 1024 listing, union connection body, bronze construction, two (2) plastic check modules, buna "N" seals, stainless steel springs and "O" ring check module and union seals. Furnish with threaded inlet and outlet connections.
- C. Pressure type in-line vacuum breaker assemblies shall be similar to Watts model no. 800M4QT anti-siphon type with ASSE 1020 listing, bronze construction, isolation valves, test cocks, check assemblies, wall/panel escutcheons and maximum 140 degrees F. temperature rating.
- D. Dual check backflow preventors with intermediate atmospheric vent assemblies shall be similar to Watts model no. SD2 with ASSE 1032 listing, bronze construction, primary and secondary check valves, stainless steel fittings and integral strainer. Furnish with threaded inlet, outlet and vent connections.
- E. Dual check backflow preventors with intermediate atmospheric vent assemblies for beverage dispenser supply piping shall be similar to Watts model no. SD3-LS with ASSE 1022 listing, stainless steel construction, primary and secondary check valves. Furnish with threaded inlet, outlet and vent connections.
- F. Double check backflow preventor assemblies shall be similar to Watts model no. 007 for sizes up to and including 2"; sizes larger than 2" to be similar to Watts no. 709. Complete assemblies are to be provided in compliance with ASSE standard 1015, including two (2) isolation/service shut-off valves (N.R.S. for domestic service; O.S.&Y. for fire protection), two (2) check valves, and test cocks. Provide with threaded connections for sizes 2 1/2" and smaller, flanged connections for sizes 3" and larger.
- G. At all hose thread outlet connections to the domestic water supply system not furnished with an integral backflow prevention device, provide a vacuum breaker similar to Watts model no. NF8 permanently affixed, with ASSE 1011 3/4" hose thread connection at outlet.
- H. Unless indicated otherwise, backflow prevention assembly size shall be as indicated by piping size where installed on plans.

- I. All backflow prevention assemblies in finished/exposed locations to be furnished with polished chrome finish with wall/panel/ceiling piping escutcheons.
- J. Backflow preventors to be rated for 125 psig working pressure.
- K. Equal assemblies as manufactured by Watts, Zurn, Wilkins, Febco, Conbraco, Hersey, Ames, Clayton, Aero or Lawler may be furnished at the contractor's option.

2.11 SECONDARY WATER METER

- A. Magnetic modular disc type meter with npt connections rated for 150 psig working pressure, two-piece bronze measuring chamber, integral strainer, hermetically sealed register with hinged cover, bronze construction with stainless steel trim and molded plastic measuring disc piston. Maximum temperature rating of 110 degrees F., and register with readout in U.S. gallons. Peak flow capacity at maximum 5 psig pressure drop, flow range as indicated on plans.
- B. Meter assemblies as manufactured by Badger, Elster, Hersey, Kent, Neptune, Equimeter or Sensus may be furnished at the contractor's option.

2.12 Panel/wall mounted water outlet fittings to be similar to Water Saver Faucet Co. model no. L-706, with brass construction, integral vacuum breaker, union connection body, panel/wall flange, four-arm operator handle and serrated outlet tip. Provide polished chrome finish on all exposed surfaces in finished areas (including panel/wall flange), and "CW" user identification tag. Equal fittings as manufactured by Chicago Faucet or T & S Brass may be furnished at the contractor's option.

2.13 In-line water filters to be similar to Watts series WUS assemblies with opaque filter housing, union connection body rated for 125 psig working pressure and maximum 115 degrees F. temperature, and nominal 2 gpm flow rate. Provide 5 micron retention cartridge for particle removal and activated carbon cartridge for organics removal, as indicated on plans. All components to be listed for potable water service. Equal assemblies as manufactured by Oasis, Elkay, Culligan, Eco-Water or Bruner may be provided at the contractor's option.

2.14 Wall mounted utility box (for clothes washers and similar applications) to be similar to Guy Gray model no. BB-200TS with 2" drain outlet, individual 1/2" hot and cold water supplies (upfeed or downfeed, as required by installation conditions), angle body shut-off valves and fully recessed wall installation box with trim frame at wall surface. Unless indicated otherwise, install with box centerline at 48" above floor.

PART 3 EXECUTION

3.01 All piping that supplies a flush valve, solenoid valve (other than slow-closing type), foot pedal operator, spring return operator or other quick closing type device shall have a shock absorber installed in accordance with the manufacturer's recommendations. Unless indicated otherwise, where multiple fixtures or equipment in adjacent locations (such as within a chase or other enclosure) are supplied by common piping manifold, a properly sized and installed shock absorber may be utilized.

3.02 Branches to fixtures the following sizes unless otherwise indicated:

- A. Water Closets, F.V. - 1 1/2 inch
- B. Water closets, tank - 1/2 inch
- C. Drinking Fountains - 1/2 inch
- D. Electric water coolers - 1/2 inch
- E. Urinals, F.V. - 3/4 inch

- F. Lavatories - 1/2 inch HW and CW
- G. Sinks - 1/2 inch HW and CW
- H. Clinic sink – 3/4 inch HW and 1 inch CW
- I. Mop Sink - 1/2 inch HW and CW
- J. Service sink - 1/2 inch HW and CW
- K. Hose Bibbs (exterior) - 3/4 inch
- L. Hose Bibb (interior) - 1/2 inch
- M. Individual showers - 1/2 inch HW and CW
- N. Bathtubs - 1/2 inch HW and CW
- O. Wash Fountain - 1 inch HW and CW

Unless otherwise shown on drawings, this Contractor shall be responsible for sizing domestic water piping in chases, etc. to individual fixtures. When piping serves flush valves, cold water pipe shall be run full size to end of pipe chase run and a listed shock absorber installed. When cold water pipe is 2" or above and serves flush valves, the pipe main in the chase can only be reduced to 1-1/2" size. 1/2" hot water pipe shall serve up to four (4) lavatories. Other pipe sizing criteria shall be as outlined in the current edition of "ASHRAE Fundamentals Handbook".

- 3.03 Run all water piping level and conceal wherever possible. Piping to be installed to allow complete drain down of system back to main riser(s) at base of system whenever possible. Provide 3/4" drains at base of riser(s), and any other trapped or low points when such are unavoidable due to project conditions. 3/4" Drains to consist of ball valve with outlet connection vacuum breaker as specified herein.
- 3.04 Install an in-line pressure type vacuum breaker as specified herein in the individual/dedicated supply piping for all valves, fittings, trim or other elements with serrated ends or other outlets capable of hose connection that do not include an integral listed/approved backflow prevention device.
- 3.05 Balance recirculating branch line flows as required for proper operation of systems. Provide combination balance/shut-off valves, check valve, thermometer and Pete's plugs for each branch recirculating line.
- 3.06 Horizontal supply piping below slabs on grade to be installed entirely below the slab structure, including conduit sleeve when provided. Underslab piping and/or conduit shall not be embedded in or support slab structures.
- 3.07 Coordinate installation with structure, site conditions and work of other trades at and adjacent to domestic water service piping installation.
- 3.08 Maintain necessary clearance from structural support elements as required for installation of domestic water service piping outside of support/bearing zones.
- 3.09 Piping shall be installed according to the pipe manufacturer's specifications & recommendations including preparation, joining methods, allowances for expansion/contraction, bedding, backfill, support & restraint.

End of Section

## SECTION 22 11 19 - 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. Thermometers
  - 2. Pressure Gauges
  - 3. Flexible Vibration Joints
  - 4. Backflow preventers.
  - 5. Water pressure-reducing valves.
  - 6. Balancing valves.
  - 7. Temperature-actuated water mixing valves.
  - 8. Strainers.
  - 9. Outlet boxes.
  - 10. Hose bibbs.
  - 11. Wall hydrants.
  - 12. Water hammer arresters.
  - 13. Trap-seal primer valves.
- 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.

#### 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. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. 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 BACKFLOW PREVENTERS

- A. Reduced-Pressure-Principle Backflow Preventers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Conbraco Industries, Inc.
    - c. FEBCO; SPX Valves & Controls.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1013.
  - 3. Operation: Continuous-pressure applications.
  - 4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
  - 5. Size: 3 NPS.
  - 6. Design Flow Rate: 120 gpm.
  - 7. Body: Stainless steel for NPS 2-1/2 and larger.
  - 8. End Connections: Flanged for NPS 2-1/2 and larger.
  - 9. Configuration: Designed for horizontal, straight through flow.
  - 10. Accessories:
    - a. Valves: 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.
- B. Double-Check Backflow-Prevention Assemblies <Insert drawing designation if any>:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Conbraco Industries, Inc.
    - c. FEBCO; SPX Valves & Controls.
    - d. Watts Industries, Inc.; Water Products Div.
    - e. Zurn Plumbing Products Group; Wilkins Div.
  - 2. Standard: ASSE 1015.
  - 3. Operation: Continuous-pressure applications, unless otherwise indicated.
  - 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
  - 5. Size: 6 NPS - 8 NPS.

6. Design Flow Rate: 500 **gpm** – 1000 **gpm**.
7. Body cast iron with interior lining complying with AWWA C550 or that is FDA approved or steel with interior lining complying with AWWA C550 or that is FDA approved for **NPS 2-1/2** and larger.
8. End Connections: Flanged for **NPS 2-1/2** and larger.
9. Configuration: Designed for horizontal, straight through flow.
10. Accessories:
  - a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet of **NPS 2-1/2** and larger.

## 2.2 WATER PRESSURE-REDUCING VALVES

### A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
  - c. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of **150 psig**.
4. Size: 3 **NPS**.
5. Design Flow Rate: 140 **gpm**.
6. Design Inlet Pressure: 100 **psig**.
7. Design Outlet Pressure Setting: 80 **psig**.
8. Body: Cast iron with interior lining complying with AWWA C550 or that is FDA approved for **NPS 2-1/2 and NPS 3**.
9. End Connections: Flanged for **NPS 2-1/2 and NPS 3**.

## 2.3 BALANCING VALVES

### A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ITT Industries; Bell & Gossett Div.
  - b. Watts Industries, Inc.; Water Products Div.
2. Type: Ball valve with two readout ports and memory setting indicator.
3. Body: Bronze.
4. Size: Same as connected piping, but not larger than NPS 2.
5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

## 2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

### A. Primary, Thermostatic, Water Mixing Valve::

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc. “The Brain”
2. Standard: ASSE 1017.
3. Pressure Rating: 125 **psig**.
4. Type: Cabinet-type, thermostatically controlled water mixing valve.

5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
9. Tempered-Water Setting: 120 deg F.
10. Tempered-Water Design Flow Rate: 50 gpm.
11. Valve Finish: Chrome plated.
12. Piping Finish: Copper.

## 2.5 STRAINERS FOR DOMESTIC WATER PIPING

### A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron[ with interior lining complying with FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
  - a. Strainers NPS 2 and Smaller: 0.033 inch.
  - b. Strainers NPS 2-1/2 to NPS 4: 0.062 inch.

## 2.6 OUTLET BOXES

### A. Clothes Washer Outlet Boxes:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Acorn Engineering Company.
  - b. Guy Gray Manufacturing Co., Inc.
  - c. IPS Corporation.
  - d. LSP Products Group, Inc.
  - e. Oatey.
2. Mounting: Recessed.
3. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
4. Faucet: Combination valved fitting or separate hot- and cold-water, valved fittings complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
5. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 copper, water tubing.
6. Drain: NPS 2 standpipe and P-trap for direct waste connection to drainage piping.
7. Inlet Hoses: Two 60-inch- long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
8. Drain Hose: One 48-inch- long, rubber household clothes washer drain hose with hooked end.
9. copper, water tubing.

## 2.7 HOSE BIBBS

### A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. Prier Products, Inc.
  - c. Woodford Manufacturing Company.
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle.
13. Operation for Service Areas: Wheel handle.
14. Operation for Finished Rooms: Loose key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

## 2.8 WALL HYDRANTS

### A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. Prier Products, Inc.
  - c. Woodford Manufacturing Company.
2. Standard: ASME A112.21.3M for exposed-outlet, self-draining wall hydrants.
3. Pressure Rating: 125 psig.
4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
9. Nozzle and Wall-Plate Finish: Rough bronze.
10. Operating Keys(s): One with each wall hydrant.

## 2.9 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. MIFAB, Inc.
- b. PPP Inc.
- c. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## 2.10 TRAP-SEAL PRIMER VALVES

### A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. MIFAB, Inc.
  - b. PPP Inc.
  - c. Sioux Chief Manufacturing Company, Inc.
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

## 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 regulators with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.
- D. Install balancing valves in locations where they can easily be adjusted.
- E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.

- F. Install water hammer arresters in water piping according to PDI-WH 201.
- G. Install air vents at high points of water piping.
- H. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.
- B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each reduced-pressure-principle backflow preventer 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.

### 3.4 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

**END OF SECTION**

## SECTION 22 13 16 - 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. Section Includes:
  - Pipe, tube, and fittings.
  - Specialty pipe fittings.

#### PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - Soil, Waste, and Vent Piping: 10-foot head of water.

#### SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Field quality-control reports.

#### QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

#### 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.

#### HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 74, Service class (es).
- B. Gaskets: ASTM C 564, rubber.

#### HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. ANACO-Husky.
  - b. Mission Rubber Company; a division of MCP Industries, Inc.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 PVC PIPE AND FITTINGS; not approved for installation within return air plenums.

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
- D. Solvent Cement: ASTM D 2564.

2.5 COPPER TUBE AND FITTINGS

- A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.
- B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.6 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. Shielded, Nonpressure Transition Couplings:
  - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - 1) Cascade Waterworks Mfg. Co.
    - 2) Mission Rubber Company; 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 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. 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 two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. 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.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
  - 3. Vent Piping: Down toward vertical fixture vent or toward vent stack.

- M. 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."
- 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
  - N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."
  - O. Install underground PVC piping according to ASTM D 2321.
  - P. Plumbing Specialties:
    - 1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
    - 2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  - Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### 3.3 JOINT CONSTRUCTION

- A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
- 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 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.
- D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.
- E. Plastic, Non-pressure-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. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

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, non-pressure transition couplings.
  - a. NPS 8 and Smaller: Fitting-type transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION; See specification section 22 05 29.

3.6 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
  6. 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.
- D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.7 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.8 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary 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 15 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.
  - 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 AND PROTECTION

- 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.
- D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

### 3.10 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 6 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
- C. Aboveground, vent piping NPS 6 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings; heavy-duty hubless-piping couplings; and coupled joints.
  - 2. Copper DWV tube, copper drainage fittings, and soldered joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.



- D. Underground, soil, waste, and vent piping in Mechanical Room Floor, shall be the following:
  - 1. Service class, cast-iron soil piping; push gasket joints and hub fittings.
- E. Underground, soil and waste piping shall be the following:
  - 1. Solid-wall PVC pipe; PVC socket fittings; and solvent-cemented joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

END OF SECTION

## SECTION 22 13 19 - 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. Cleanouts.
  2. Floor drains.
  3. Through-penetration firestop assemblies.
  4. Miscellaneous sanitary drainage piping specialties.
  5. Flashing materials.

#### 1.3 DEFINITIONS

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. PVC: Polyvinyl chloride plastic.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:
  1. Floor drains
  2. Cleanouts
  3. Flashing material
  4. Piping Specialties.
- B. Shop Drawings: Show fabrication and installation details.
- C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

## 1.6 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

## PART 2 - PRODUCTS

### 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - b. Tyler Pipe; Wade Div.
    - c. Watts Drainage Products Inc.
    - d. Zurn Plumbing Products Group; Specification Drainage Operation.
    - e. Josam Company; Blucher-Josam Div.
  - 2. Standard: ASME A112.3.1 for cleanout test tee.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: PVC soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk, plastic plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
- B. Metal Floor Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. Tyler Pipe; Wade Div.
    - c. Watts Drainage Products Inc.
    - d. Zurn Plumbing Products Group; Specification Drainage Operation.
    - e. Josam Company; Blucher-Josam Div.
  - 2. Standard: ASME A112.36.2M for adjustable housing cleanout.
  - 3. Size: Same as connected branch.
  - 4. Type: Adjustable housing.
  - 5. Body or Ferrule: Cast iron and PVC.
  - 6. Clamping Device: Not required.
  - 7. Outlet Connection: Inside calk.
  - 8. Closure: Brass plug with tapered threads.
  - 9. Adjustable Housing Material: Cast iron set-screws or other device.
  - 10. Frame and Cover Material and Finish: Stainless steel.
  - 11. Frame and Cover Shape: Round.
  - 12. Top Loading Classification: Heavy Duty.
  - 13. Standard: ASME A112.3.1.
  - 14. Size: Same as connected branch.

## 2.2 FLOOR DRAINS

### A. Cast-Iron Floor Drains:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - c. Tyler Pipe; Wade Div.
  - d. Watts Drainage Products Inc.
  - e. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Body Material: Gray iron.
3. Outlet: Bottom.
4. Top or Strainer Material: Nickel bronze.
5. Top Shape: Round.
6. Top Loading Classification: Medium Duty.

## 2.3 THROUGH-PENETRATION FIRESTOP ASSEMBLIES; See section 22 05 17.

## 2.4 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. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

### C. Stack Flashing Fittings:

1. Description: Counter flashing-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.

## 2.5 FLASHING MATERIALS

### A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

- B. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

### **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 for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. 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 roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
  - G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
  - H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.
  - I. Assemble open drain fittings and install with top of hub 1 inch above floor.
  - J. Install deep-seal traps on floor drains and other waste outlets, if indicated.
  - K. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
  - L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
  - M. Install vent caps on each vent pipe passing through roof.
  - N. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
  - O. Install wood-blocking reinforcement for wall-mounting-type specialties.
  - P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

### 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 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
  1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft, 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft, 0.0625-inch thickness or thinner.
  2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
  2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
  3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
- 3.4 FIELD QUALITY CONTROL
- A. Tests and Inspections:
1. Leak Test: After installation, charge system 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.

### 3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

**END OF SECTION**

**HVAC SPECIFICATIONS - INDEX**

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## SECTION 23 01 05 - HVAC GENERAL PROVISIONS

### PART 1 GENERAL

#### 1.1 GENERAL REQUIREMENTS

- A. Furnish all labor, materials, tools, incidentals and details necessary to provide a complete mechanical system, ready to operate, including but not limited to the items listed under the HVAC Specification Indexes. Primary scope items for the project include:
  - 1. Remove existing heating only HVAC units.
  - 2. Remove steam Convectors, finned tube radiant heating.
  - 3. Add new Hot Water and Chilled Water Piping on floors three and four, connecting to existing risers.
  - 4. Add new air handling units and return air fans.
  - 5. Add new hot water finned tube heating with architectural cabinets.
  - 6. Add new humidifiers for designated duct branches serving future gallery spaces.
  - 7. Provide new Temperature Control devices and controllers for new equipment and integrate into existing systems. Provide graphical user interfaces conforming to OU standards.
- B. Scheduling of all work performed by this contractor shall be completely coordinated with the Contractor and Ohio University.
- C. Include any minor details essential to successful operation and any other items specified or shown on the Drawings.
- D. The Contractor is required to read the Specifications covering all branches of the work and will be held responsible for coordination of his work with work performed under all other Contracts.
- E. The Contractor must visit the site and fully inform themselves concerning all conditions affecting the scope of his work. Failure to visit the site shall not relieve the Contractor from any responsibility in the performance of his Contract.
- F. The Contractor shall contact the A/E immediately if there is any question regarding the meaning or intent of either Plans or Specifications, or if he notices any discrepancies or omissions in either Plans or Specifications.
- G. Other than minor adjustments shall be submitted to the A/E for approval before proceeding with the work.
- H. Submit on letterhead, along with the Bid confidence letter, the manufacturer's name and the names of all Subcontractors to whom you intend to sublet the work.

- I. Furnish to Ohio University a written description of procedure on this job including scheduling of the work to be done for approval. This shall be submitted within 10 days after the Contract is awarded.
- J. All material hoisting by trade involved.
- K. Arrangements for storage of tools and material, removal of debris, and interruptions of services shall be made with the University.
- L. All connections to, or revisions in, existing piping or facilities shall be done at such time as agreed to by Ohio University and all work shall be scheduled as required under "General Conditions". Revisions to the existing piping systems must be done with the minimum of shutdown time and at times agreed to by Ohio University. All piping shall be run to the point of new connections and new equipment installed and ready to operate before any connections are to be made.
- M. Extreme care shall be taken to avoid interference with the University's equipment. Consult with the A/E regarding any points where interference is likely to occur and follow dimensions carefully where given on the Drawings. Pay particular attention to minimum clear heights when indicated on the Drawings.
- N. It is mandatory that dust and debris be held to a minimum to protect sensitive and priceless art and artifacts on adjacent floors. This Contractor shall provide drop cloths, screens, curtains, etc., to protect existing occupied spaces from dust and dirt during the course of his work. All damage to existing construction or finishes shall be repaired by this Contractor upon removal of dirt and dust protection devices. All dirt, dust and other protection devices shall be approved by Ohio University before any work is started in the area involved.
- O. At all times, keep the premises and the building in a neat and orderly condition. This includes using a vacuum cleaner in adjacent occupied areas. Use of the elevator shall be limited as much as possible to avoid transferring dust and dirt from construction areas to existing gallery and art spaces. Contractor shall use exhaust and HEPA filtration in construction zones to avoid dirt contamination of occupied spaces.
- P. At the completion of the project, promptly clean up and remove from the site, all debris and excess materials.

## 1.2 DRAWINGS

- A. Consult all Contract Drawings which may affect the locations of any equipment, apparatus, piping and ductwork and make minor adjustments in location to secure coordination.
- B. Piping and duct layout is schematic and exact locations shall be determined by structural and other conditions and verified in the field. This shall not be construed to mean that the design of the system may be changed, it refers only to the exact location of piping and ductwork to fit into the building as constructed, and to coordination of all work with piping and equipment included under other Divisions of the Specifications.
- C. The layout shown on the Drawings is based on a particular make of equipment. If another make of equipment is used which requires modifications or changes of any description from the Drawings or Specifications, this Contractor shall be responsible for making all such modifications and changes, including those involving other trades, as a part of this Contract and the cost thereof shall be included in his Bid. In such case, the Contractor shall submit Drawings and Specifications showing all such modifications and changes prior to starting work, which shall be subject to the approval of the A/E.

- D. The A/E reserves the right to make minor changes in the location of piping and equipment up to the time of rough-in without additional cost to Ohio University.
- E. Where certain grades and/or elevations are given on the Drawings, they have been obtained from the best information available; however, they are not guaranteed. This Contractor must assume the full responsibility of verifying present elevations in the field and making any adjustments as may be necessary, all of which must be included in his Bid Price.
- F. Due to the scale of the Drawings, it is impossible to show all offsets and transitions which may be required. This Contractor shall carefully investigate the conditions affecting all work and shall furnish all elbows, fittings, transitions, etc., required to accomplish the desired result at no additional cost to Ohio University.
- G. Install all work as close as possible to walls, ceilings, struts, members, etc., consistent with the proper space for covering, access, etc., so as to occupy the minimum of space.
- H. Actual dimensions shown on the Drawings and field dimensions shall take precedence over scaled dimensions.

### 1.3 PERMITS, INSPECTIONS AND CODES

- A. The A/E shall secure the required structural, plumbing, HVAC, and electrical plan approvals from the Ohio Department of Commerce. The contractor shall obtain, maintain and pay for any permit, inspections, or license applicable to their trade.
- B. Completed installations shall conform with all applicable Federal, State and Local Laws, Codes and Ordinances, including but not limited to the following:
  - 1. Ohio Building Code, Department of Industrial Relations, State of Ohio.
  - 2. Specific Safety Requirements Relating to Building and Construction Work, Industrial Commission and Department of Industrial Relations, State of Ohio.
  - 3. Specific Safety Requirements Covering the Installation of Pressure Piping Systems, Industrial Commission and Department of Industrial Relations, State of Ohio.
  - 4. Ohio Pressure Piping Systems Rules, Ohio Board of Building Standards and Department of Industrial Relations, State of Ohio.
  - 5. A.S.M.E. Pressure Piping Code - Section B31.1
  - 6. National Electrical Code, Bulletin No. 70, National Fire Protection Association.
  - 7. Air Conditioning and Ventilating, Bulletin No. 90 A, National Fire Protection Association.
  - 8. Life Safety Code, Bulletin No. 101, National Fire Protection Association.
  - 9. All Work Under Jurisdiction of Local Fire Marshal shall conform to requirements set forth by Fire Marshal's Office and National Fire Protection Association.
  - 10. Ohio University Design and Construction Standards, latest edition..

- C. Nothing contained in the Plans and Specifications shall be construed to conflict with these laws, codes and ordinances and they are hereby made a part of these Specifications.

1.4 OHIO ENERGY CODE

- A. The Mechanical System must comply with all requirements of the State of Ohio "Code for Energy Conservation". This includes, but is not limited to, efficiencies, power factors, insulation thickness, etc.
- B. All motors 1 HP or more shall be "energy efficient" motors meeting all requirements of ASHRAE Standard 90.1 (2010 Version).

1.5 UTILITIES

- A. Investigate and locate all utilities prior to construction.
- B. Each Contractor is responsible for rerouting or replacing existing utilities where necessary to permit installation of his work.
- C. The identity and location of the existing underground utility facilities known to be located in the construction area have been shown on the plans as accurately as previous engineering documents. The A/E assume no responsibility as to the accuracy or the depths of the underground facilities shown on the plans.
- D. Support, protection and restoration of all existing utilities and appurtenances shall be the responsibility of the Contractor. The cost of this work shall be included in the price bid for the various items.
- E. Give notice to the Ohio Utilities Protection Service (telephone 800-362-2764 - toll- free) and to the Universities Utility Department of underground utility facilities shown on the plans who are not members of a registered underground protection service in accordance with Section 153.64 of the Revised Code. The above mentioned notice shall be given at least 48 hours, excluding Saturdays, Sundays and legal holidays, prior to commencing work.
- F. Alert immediately the occupants of nearby premises as to any emergency that he may create or discover on or near such premises of the underground facility, any break or leak on its lines or any dent, gouge, groove or other damage.
- G. Procedure for making connections to existing utilities shall be planned at least two weeks in advance of the work and the work shall be executed in a manner to provide reasonably continuous service throughout the construction period. Connections shall be made only at times approved by Ohio University. For interruption of service in major utility systems, the Contractor must submit to the A/E a step-by-step sequence of operations planned to accomplish the work. Outline must show tentative dates and times of day for shut-off and restoration of services. The A/E will review the information given with Ohio University, who, upon approval of the planned operations, will make arrangements with appropriate Ohio University personnel for interruption of services. If Ohio University's assistance is anticipated for utility connections/disconnections consult with the Utilities Facilities to obtain current construction outage charges. Charges for Ohio University's assistance for building systems outages may be obtained by consulting with the Facilities. Caution to Bidders: Bidders are cautioned that the University will probably schedule interruption of services at times other than the contractors' normal working hours and that only designated Ohio University personnel are authorized to interrupt services. Frequently, outages are scheduled between quarters to reduce disruption of classes.

1.6 OPERATING AND MAINTENANCE INSTRUCTIONS

- A. Thoroughly instruct and supervise Ohio University's Maintenance Personnel in the proper operation and maintenance of the mechanical system equipment. Arrange for the instruction and supervision at a time convenient to Ohio University and notify the A/E of the time at least 48 hours in advance.

Instructions shall include the following:

1. Location of equipment and explanation of what it does.
  2. Reference to "Operating Instruction Manuals" for record and clarity.
  3. Coordination of written and verbal instruction so that each is understood by all personnel.
  4. Explanation of Temperature Control System including panels.
  5. Specific maintenance to be performed by Ohio University.
- B. Furnish one (1) copy of the printed Operating and Maintenance Instructions for the Heating, Ventilating, and Air Conditioning Systems to the A/E for review. Copy shall be neat, legible and bound in a hardback 3-ring notebook. After final approval, provide four (4) copies and one (1) electronic PDF copy of Operation and Maintenance Instructions for submittal to Ohio University. Instructions shall consist of the following items:
1. Title Page: Title of Project, address, date of submittal, name and address of Contractor, name of Engineer.
  2. Second Page: Index of Manual Contents.
  3. First Section: A copy of each approved shop drawing and submittal with an index at the beginning of the section.
  4. Second Section: A list of all equipment used on the project, together with supplier's name and address.
  5. Manufacturer's maintenance manuals for each item of equipment furnished under this contract. Manuals shall include such items as parts list, detailed lubrication instructions, procedures for performing normal maintenance functions, preliminary trouble shooting procedures and wiring diagrams.
  6. Complete wiring diagrams for the mechanical systems as actually wired including control and interlock wiring.
  7. Brief but complete instructions for start-up, shut- down and routine maintenance of each system.
  8. Routine and 24-hour emergency information:
    - a. Name, address and telephone number of servicing agency.
    - b. Include names of personnel to be contacted for service arrangements.

- C. Frame one (1) copy of brief start-up, shut-down and routine maintenance instructions and complete system wiring diagrams under glass and mount on the Equipment Room wall. Temperature Control schematics may be laminated with plastic at the Contractor's option.

#### 1.7 RECORD DOCUMENTS

- A. Keep an accurate record of all deviations from Contract Drawings and Specifications. Neatly and correctly enter in colored pencil any deviations on Drawings affected and keep the Drawings available for inspection. Extra sets of Drawings will be furnished for this purpose.
- B. At the completion of project and before final approval, make any final corrections to Drawings and certify to the accuracy of each print by signature and deliver same to the University.

#### 1.8 SUPERVISION

- A. A competent superintendent experienced in the work installed under this Contract shall be in charge of the work on the job during construction.

#### 1.9 UNACCEPTABLE WORK AND OBSERVATION REPORTS

- A. Work shall be unacceptable when found to be defective or contrary to the Plans, Specifications, Codes specified or accepted standards of good workmanship.
- B. Promptly correct all work found unacceptable by the A/E or Ohio University, whether observed before or after substantial completion and whether or not fabricated, installed or completed. Bear all costs of correcting such unacceptable work, including compensation for the A/E or Ohio University's additional services made necessary thereby.
- C. During the course of construction, the A/E will prepare "Observation Reports" with a list of items found to be in need of correction. All items listed shall be corrected by the Contractor. A space is provided on the form for the Contractor to note the completion of each item. All prior "Observation Report" items must be completed, the lists signed and returned to the A/E prior to making the final inspection. After the final list is issued, the same procedure will apply.

#### 1.10 FINAL INSPECTION

- A. When the Contractor determines all work is completed and working properly per the Contract Documents, he shall request a "final" inspection by the A/E in writing. If more than one re-inspection is required after this final inspection, the Contractor shall bear all additional costs including compensation for the A/E's additional services made necessary thereby. A final inspection will not be made until Operating and Maintenance Manuals and Air Balance Reports are submitted and approved and all prior "Observation Report" punch lists completed, signed and returned to the A/E.
- B. As part of the final checkout of the project, the A/E will be checking out the operation of the various systems. This Contractor shall provide such assistance as required (including manpower and tools) to start and stop the various systems, open and close valves etc. and simulate summer, winter and other temperature control sequences. The Contractor (not the A/E) is responsible to turn on the systems and demonstrate they are operating properly.

1.11 GUARANTEE

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year after final payment is approved by A/E and Ohio University.

**PART 2 PRODUCTS**

Not Applicable.

**PART 3 EXECUTION**

Not Applicable.

**END OF SECTION**





## SECTION 23 01 10 - MANUFACTURER'S AND COORDINATION DRAWINGS

### PART 1 GENERAL

#### 1.1 SCOPE

- A. Submit to the A/E for review, within 4 weeks after date of contract, electronic copies of manufacturer's drawings, wiring diagrams, pump and fan curves or data. The A/E will review Contractor's shop drawings and related submittals (as indicated below) with respect to the ability of the detailed work, when complete, to be a properly functioning integral element of the overall system designed by the A/E. Before submitting a shop drawing or any related material to the A/E: review each such submission for conformance with the means, methods, techniques, sequences, and operations of construction, and safety precautions and programs incidental thereto, all of which are the sole responsibility of Contractor; approve each such submission before submitting it; and so stamp each such submission before submitting it. The A/E shall assume that no shop drawing or related submittal comprises a variation unless Contractor advises A/E otherwise via a written instrument which is acknowledged by A/E in writing. The shop drawings and related material (if any) called for are indicated below:

#### Heating, Ventilating and Air Conditioning Contract

Valves  
Piping and Accessories  
HVAC ductwork  
Air Handling Units  
Air Handling Unit Filters/Air Cleaner  
Louvers  
Grilles, Registers, and Diffusers  
Finned Tube  
Unit Heaters  
Dampers  
HVAC Insulation  
VAV Terminal boxes  
Electric humidifiers  
In line pumps  
Temperature Controls, including sequences and I/O points for all HVAC equipment  
Variable Frequency Drives  
3D HVAC Coordination Drawings (See item E. below)

- B. The A/E shall return shop drawings and related materials with comments provided that each submission has been called for and is stamped by Contractor as indicated above. The A/E shall return without comment material not called for or which has not been approved by Contractor.
- C. Furnish equipment shop drawings which will indicate power hook up and control connections as required for mechanical equipment. "Stock" wiring diagrams are NOT ACCEPTABLE.
- D. The manufacturer shall provide a statement on submittals that equipment furnished complies with the Ohio Energy Code. This previously relates to high efficiency motors, EER's, COP's, etc. If this is not done, submittals will be rejected.
- E. The Contractor shall create 3-dimensional (3D) coordination model with ability to output 1/4" scale, color coded coordination drawings in PDF and DWG formats for use in coordinating all

work in mechanical rooms, including but not limited to existing and new Structure, Plumbing, Fire Protection, Electrical, and Temperature Control scope with the layout of air distribution and piping systems. Contractor shall confirm existing structural conditions upon completion of demolition and abatement of all items to be removed by completing an "As-Built" survey using 3D laser scanning technology compatible with the 3D modeling software to be used in creating the coordination model and drawings.

Contractor shall provide coordination drawings to A/E within 60 days of award of Contract to Subcontractor responsible for HVAC (Division 23) scope. Contractor is responsible for providing information as to size, elevation and location proposed for all components, and for coordination of work of all Subcontractors. Final resolution of all items to be determined at project meetings held by the General Contractor.

- F. A/E's review of manufacturer's drawings or schedules shall not relieve the Contractor from compliance with the requirements of the plans and specifications.

## **1.2 QUANTITIES**

- A. Items may be referred to in singular or plural on Plans and Specifications. Contractor is responsible for determining quantity of each item.

## **PART 2 PRODUCTS**

Not Applicable

## **PART 3 EXECUTION**

Not Applicable

## **END OF SECTION**

## **SECTION 23 05 05 - DEMOLITION**

### **PART 1 GENERAL**

#### **1.1 REFERENCE**

- A. None

#### **1.2 SCOPE**

- A. This Contractor shall be responsible for removal of and modifications to the existing piping and equipment as hereinafter noted and as shown on the Drawings. All material removed and not reused in remodeling shall become the property of this Contractor and promptly removed from the site unless the Owner specifically asks to retain certain equipment.
  1. Turn over to owner any Automated Logic Control or Delta Controls components that are removed.
- B. This Contractor shall remove existing piping, equipment and appurtenances, etc., as shown on the Drawings and as specified. Equipment and systems to be removed includes but is not limited to the following:
  1. Steam radiators and associated piping, valves, and Controls. Remove piping back to mains and cap/insulate.
  2. Heating only HVAC units.
  3. Temperature Control Components Serving Equipment Being Removed or Replaced, Including All Associated Pneumatic Tubing

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.1 Relocate existing equipment as shown on the Drawings. Equipment to be relocated includes but is not limited to the following:
  - 1.
- 3.2 Specific mechanical equipment removed shall remain the property of the Owner and shall be delivered to and stored where directed by the Owner's representative.

Equipment as follows:

  - 1.

**END OF SECTION**

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CONSTRUCTION DOCUMENTS  
SEPTEMBER 9, 2024  
OU PROJECT 23002

## SECTION 23 05 13 - ELECTRICAL WORK

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Section 23 01 05 - Paragraph 1.5 - OHIO ENERGY CODE
- B. Section 25 00 00 - TEMPERATURE CONTROLS
- C. Division 26 - ELECTRICAL

#### 1.2 SCOPE

- A. This Contractor shall furnish all motors for his equipment. Motor starters, safety switches and wired junction boxes shall be furnished and installed by the Electrical Contractor except where specifically specified to be furnished with certain mechanical equipment.

#### 1.3 WORK INCLUDED - HVAC Contractor:

- A. Temperature Control wiring by Temperature Control Contractor except as noted below by Electrical Contractor.
- B. 120 volt wiring required for mechanical equipment when not shown or specified elsewhere.
- C. All control wiring required for the exhaust fans, chiller, cooling tower, refrigerant detectors and control panels.

#### 1.4 WORK INCLUDED - Electrical Contractor:

- A. All power wiring.
- B. All conduit and wiring incidental to Temperature Controls, including switches, controls, transformers and relays shall be by the Temperature Control Contractor, except wiring as indicated on the Electrical Drawings will be by the Electrical Contractor.
- C. Motor starters, contactors, and disconnects where noted under "PRODUCTS" below.
- D. Electrical Contractor shall provide 120 volt control power to a wired junction box near the Temperature Control Cabinets. Final connections to be made by the Temperature Control Contractor.

#### 1.5 SHOP DRAWINGS:

- A. The Contractor shall furnish to the Electrical Contractor, equipment shop drawings which will indicate power hook-up and control connections as required for mechanical equipment. "Stock" Wiring Diagrams are Not Acceptable.
- B. Prepare, as a part of Temperature Control shop drawings, complete terminal-to-terminal wiring diagrams. These will show terminal designations on control items and equipment. Wiring diagrams to be compatible with Electrical Drawings.

**PART 2 PRODUCTS**

- 2.1 Refer to Section 23 01 05 - Paragraph 1.5 for "Energy Code" requirements (Particularly power factor correction)
- 2.2 Refer to Division 16 - ELECTRICAL.
- 2.3 MOTORS
- A. Shall be furnished with all motor driven equipment.
  - B. Motor speed shall not exceed 1750 RPM unless higher speed is required to perform duty.
  - C. Required break horsepower shall not exceed 90 percent of the nameplate horsepower for direct driven equipment or 85 percent of nameplate horsepower for belt driven equipment.
  - D. Shall be externally lubricated, open drip proof and conform to NEMA construction standard with Class B insulation for 49 degrees C. ambient.
  - E. Motors exposed to weather or located in wet locations shall be totally enclosed fan cooled type.
  - F. Motors shall have a 1.15 service factor.
  - G. All motors 5 horsepower and greater serving air moving equipment or water pumps shall be premium efficiency.
  - H. Power factor shall be 90 percent or better.
  - I. Manufacturers: Gould, General Electric, Emerson or Baldor
  - J. All motors 1/2 HP and larger shall be three phase; all motors, 1/3 HP and smaller shall be single phase unless specified otherwise.
  - K. All single-phase motors provided by this Contractor to have built-in thermal overload protection.
  - L. All motors furnished shall have copper windings and all motors five (5) horsepower and greater shall have factory installed lifting eyebolts. All motors shall conform to ANSI and NEMA standards.
  - M. All motors used in variable speed applications shall be high efficiency type and shall be rated for use with variable frequency drives.
  - N. Aegis motor shaft grounding rings shall be provided for each motor served by a variable frequency drive.
- 2.4 Motor starters, contactors, and disconnects are provided and installed by the Electrical Contractor, unless part of packaged equipment furnished by this Contractor, or otherwise specified.

**PART 3 EXECUTION**

- 3.1 All wiring, conduits, etc., shall be in strict accordance with the requirements of the latest edition of the National Electrical Code and Division 26, Electrical specification.
- 3.2 All wiring, including low voltage wiring, shall be run in conduit.
- 3.3 Low voltage wiring may be size and type recommended by the Manufacturer and/or Temperature Control Contractor.

**END OF SECTION**





## **SECTION 23 05 16 - SLEEVES AND COLLARS**

### **PART 1 GENERAL**

#### 1.1 REFERENCE

- A. Section 23 05 21 - CUTTING AND PATCHING

#### 1.2 SCOPE

- A. This Contractor shall furnish and install all sleeves for his work. Sleeves are not required if holes are core drilled through existing walls.
- B. Provide pipe riser clamps for support at floor penetrations per Ohio Mechanical Code.

### **PART 2 PRODUCTS**

- 2.1 Sleeve material: black steel pipe, machine cut, large enough to allow 1/4" clearance all around pipe (around pipe covering on chilled water and cold water).
- 2.2 Escutcheon plates shall be split-ring chromium plated pressed steel. Plates shall be sized to cover the surface penetration and sleeve. Plates shall be installed on exposed piping in finished rooms and areas where pipes penetrate walls, floors, ceilings or overhead structure.

### **PART 3 EXECUTION**

- 3.1 Sleeves in partitions to have length equal to the thickness of finished partitions. Sleeves in floors of finished areas to project 1/8" above finished floor. Sleeves in floors of non-finished areas to project 3" above finished floor. Fill space between pipe and sleeves into exposed areas with sealing compound. Ream all sleeves before installing.
- 3.2 Where pipes pass through fire rated walls or floors, the space between the pipe and sleeve shall be filled with packing to maintain fire integrity.
- 3.3 In exposed location, other than in Mechanical Equipment Rooms, bare pipe or insulated pipe shall be provided with chromium plated collars at floor, ceiling, and at partitions.
- 3.4 Cutting required of any masonry wall or floor after it is in place shall be done by core drilling.
- 3.5 Piping not allowed to bear on sleeves.
- 3.6 Sleeves shall be installed plumb and true to line, grade, and position.
- 3.7 Unused sleeves shall be plugged and finished to match adjacent surface.

### **END OF SECTION**



## SECTION 23 05 17 - FIRESTOPPING

### PART 1 – GENERAL

#### 1.1 SCOPE

- A. Each Contractor shall be responsible for firestopping around all openings for pipes, ducts, conduits, etc., installed by him at all fire walls and smoke walls. Firestopping shall be performed by an installer who has been trained by manufacturer, or manufacturer's representative, in the installation procedures based on published UL tested fire stop systems.

#### 1.2 DEFINITIONS

- A. Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

#### 1.3 REFERENCE

- A. Section 23 05 16 – Sleeves and Collars
- B. Section 23 07 00 – HVAC Insulation

#### 1.4 GENERAL REQUIREMENTS

- A. Test Requirements: ASTM E-814, "Standard Method of Fire Tests of Through Penetration Fire Stops" (July 1997).
- B. Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E-814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually.
  - 1. UL Fire Resistance Directory:
    - a. Through-Penetration Firestop Devices (XHCR)
    - b. Fire Resistance Ratings (BXUV)
    - c. Through-Penetration Firestop Systems (XHEZ)
    - d. Fill, Voids, or Cavity Material (XHHW)
    - e. Forming Materials (XHKU)
- C. International Firestop Council Guidelines for Evaluating Firestop Systems Associateing Judgments
- D. ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. The Ohio Building Code (OBC)
- F. NFPA 101 - Life Safety Code

#### 1.5 QUALITY ASSURANCE

- A. A manufacturer's direct representative (not distributor or agent) to be on-site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures. This will be done per manufacturer's written recommendations published in their literature and drawing details.

- B. Firestop System installation must meet requirements of ASTM E-814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated.
- C. Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- D. Firestop Systems do not reestablish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural Associate prior to penetrating any load bearing assembly.
- E. For those firestop applications that exist for which no UL tested system is available through a manufacturer, a manufacturer's Associateing judgment derived from similar UL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Associate judgment drawings must follow requirements set forth by the International Firestop Council (September 7, 1994).

#### 1.6 SUBMITTALS

- A. Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL firestop systems to be used and manufacturer's installation instructions.
- B. Manufacturer's Associateing judgment identification number and drawing details when no UL system is available for an application. Associate judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- C. Submit material safety data sheets provided with product delivered to job-site.

#### 1.7 INSTALLER QUALIFICATIONS

- A. Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having been provided the necessary training to install manufacturer's products per specified requirements. A manufacturer's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and UL label where applicable.
- B. Coordinate delivery of materials with scheduled installation date to allow minimum storage time at job-site.
- C. Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- D. Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- E. Do not use damaged or expired materials.

#### 1.9 PROJECT CONDITIONS

- A. Do not use materials that contain flammable solvents.
- B. Scheduling
  - 1. Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
  - 2. Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- C. Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- D. Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- E. During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

## **PART 2 – PRODUCTS**

### **2.1 FIRESTOPPING, GENERAL**

- A. Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- B. Provide components for each firestopping system that is needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.

### **2.2 ACCEPTABLE MANUFACTURERS**

- A. Subject to compliance with through penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products of the following manufacturers as identified below:
  - 1. Hilti, Inc., Tulsa, Oklahoma, (800)879-8000
  - 2. Tremco Sealants & Coatings, Beachwood, Ohio, (216) 292-5000
  - 3. 3M Fire Protection Products, St. Paul, Minnesota, (612) 736-0203

### **2.3 MATERIALS**

- A. Use only firestop products that have been UL 1479, ASTM E-814 tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- B. Cast-in place firestop devices are installed prior to concrete placement for use with non-combustible and combustible plastic pipe (closed and open piping systems) penetrating concrete floors, the following products are acceptable:
  - 1. Hilti CP 680 Cast-In Place Firestop Device
  - 2. Fox Coupling, Inc. "Cast-In-Place Firestop Coupling".

3. Proset Cast-In-Place Device
- C. Sealant or caulking materials for use with non-combustible items including steel pipe & copper pipe, the following products are acceptable:
  1. Hilti FS-ONE Intumescent Firestop Sealant
  2. 3M Fire Barrier CP25 or Firestop Sealant 2000
  3. Tremco Fyre Shield
- D. Sealant or caulking materials for use with sheet metal ducts, the following products are acceptable:
  1. Hilti CP 601S Elastomeric Firestop Sealant or CP 606 Flexible Firestop Sealant
  2. Tremco Fyre-Shield High Performance Ceramic Firestop Sealant
  3. 3M Fire Barrier CP25WB+ or 2000 Silicone Sealant
- E. Intumescent sealant or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe and plastic pipe, the following products are acceptable:
  1. Hilti FS-ONE Intumescent Firestop Sealant
  2. 3M Fire Barrier CP25WB+
  3. Tremco Intumescent Acrylic or TremStop WBM
- F. Firestop collar or wrap devices attached to assembly around combustible plastic pipe (closed and open piping systems), the following products are acceptable:
  1. Hilti CP 642 and CP643 Firestop Collar, CP645 Wrap Strip
  2. Tremco TREMstop D Combustible Pipe Intumescent Device System and TremStop WS Wrap Strip
  3. 3M Ultra Plastic Pipe Device and Fire Barrier FS-195+ Wrap Strip
- G. Materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
  1. Hilti FS 635 Trowelable Firestop Compound and FS 657 FIRE BLOCK
  2. Tremco TremStop M Fire Rated Mortar and PS Pillows
  3. 3M Fire Barrier CS-195+ Composite Sheet
- H. Non curing, re-penetrable materials used for large size/complex penetrations made to accommodate multiple steel and copper pipes, the following products are acceptable:
  1. Hilti FS 657 FIRE BLOCK
  2. Tremco PS Firestop Pillows
  3. 3M CS Intumescent Sheet
- I. Provide a firestop system with an "F" Rating as determined by UL 1479 or ASTM E814. The F rating must be a minimum of one (1) hour but not less than the fire resistance rating of the assembly being penetrated.

### **PART 3 – EXECUTION**

#### **3.1 PREPARATION**

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
  - 1. Verify penetrations are properly sized and in suitable condition for application of materials.
  - 2. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
  - 3. Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
  - 4. Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
  - 5. Do not proceed until unsatisfactory conditions have been corrected.

### 3.2 COORDINATION

- A. Coordinate location and proper selection of cast-in-place Firestop Devices with trade responsible for the work. Ensure device is installed before placement of concrete.
- B. Responsible trade to provide adequate spacing of field run pipes to allow for installation of cast-in-place firestop devices without interferences.

### 3.3 INSTALLATION

- A. Regulatory Requirements: Install firestop materials in accordance with UL Fire Resistance Directory.
- B. Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration joint materials.
  - 1. Seal all holes or voids made by penetrations to ensure an air and water resistant seal.
  - 2. Consult with mechanical Associate and damper manufacturer prior to installation of UL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
  - 3. Protect materials from damage on surfaces subjected to traffic.

### 3.4 FIELD QUALITY CONTROL

- A. Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas. All penetrations are to be labeled in accordance with Ohio University's standard labeling system. The Contractor shall coordinate all fire stopping requirements with Ohio University prior to start of work.
- B. Keep areas of work accessible until inspection and approval have been completed.
- C. All fire stopping shall be inspected and approved by a licensed independent Consultant. All unapproved fire stopping products installed by this contractor will be removed and replaced at his expense.

- D. Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.

3.5 ADJUSTING AND CLEANING

- A. Remove equipment, materials and debris, leaving area in undamaged, clean condition.
- B. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

**END OF SECTION**



## SECTION 23 05 19 - PIPING SPECIALTIES

### PART 1 GENERAL

#### 1.1 SCOPE

- A. Furnish and install all necessary piping specialties to include thermometers, gauges, pipe strainers, etc., for piping systems included under this Contract.

### PART 2 PRODUCTS

#### 2.1 Thermometers

- A. Thermometers shall be located in the following locations (minimum):
  - 1. Supply and return of heating hot water piping at air handling units.
  - 2. Supply and return of chilled water piping at air handling units.
  - 3. Where indicated on piping details and piping schematics.
- B. Thermometers shall be light-powered, digital thermometers with Fahrenheit scale, recalibration feature, adjustable head, brass separable socket, LCD with minimum 3/8-inch characters, high-impact ABS or cast aluminum case, and glass-passivated thermistor. Minimum range shall be minus 40 to plus 300 degrees F. Minimum ambient operating range shall be minus 30 to plus 140 degrees F. Thermometer shall have a lux rating of 10 lux (1 footcandle) and require no batteries.
- C. Dial thermometers minimum 4½" diameter will be acceptable in certain fluid applications. Consult with A/E.
- D. Ranges as shown on the Drawings.
- E. Separable socket insertion well shall be furnished with each thermometer. An extension neck socket, with appropriate increase in thermometer stem length, shall also be furnished where insulation thickness exceeds 2 in.
- F. Dial thermometers shall be used in air ductwork, bi-metal vari-angle, Weiss or approved equal.
- G. Thermometers shall not be positioned over 6-feet above the floor; install remote head type of thermometers as required to conform to this restriction.

#### 2.2 Pressure Gauges

- A. Pressure gauges shall be located at the following locations (minimum):
  - 1. Suction and discharge of pumps.
  - 2. Central station AHU coil supply and return piping.
  - 3. Where indicated on piping details and piping schematics.

- B. Pressure gauges, including compound gauges and vacuum gauges, shall be Bourdon tube type with 4.50 in. dial and cast aluminum case, equal to Trerice 600C Series or equal by Ashcroft, marsh, Marshalstown, Kunkle, or Weiss Instruments. Accuracy shall be 1% at mid-range.
- C. A brass cock or bronze ball valve and a pressure snubber shall be furnished with each pressure gauge. A brass cock, snubber and syphon loop shall be furnished with each steam pressure gauge.
- D. Ranges as shown on the Drawings.
- E. Provide separate gauges on inlet and discharge. Do not use a single gauge with a valved manifold.

2.3 Pete's Plug -

- A. Pressure-temperature test plugs for insertion of pressure gauge or thermometer shall be a brass fitting with neoprene or Nordel self-sealing insert and knurled brass cap with plastic capture tab. Fittings shall be equal to Petersen "PT".
- B. Provide XL (extra long) type Pete's plug in insulated lines.
- C. Sisco plugs may be furnished at the Contractor's option.

2.4 Air Vents

- A. Air vents shall be as manufactured by Bell and Gossett, TACO, Trane, Thrush, Dunham Bush or Hoffman. Install at high points of system on each heating and cooling coil and at other locations subject to air binding.
  - 1. Manual air vents shall be ball valves piped as detailed on the drawings. For use on individual heating elements.
  - 2. Manual air vent for finned radiation and cabinet unit heater cabinets shall be all brass cock, 1/8" pipe tap, Powell 914.
  - 3. Large capacity for use on central coils and for venting mains shall have a cast iron body and bonnet with stainless steel, brass and EPDM internal components. Vent shall be suitable for a maximum operating temperature of 250 degrees F and a maximum operating pressure of 150 psi. Vents shall have 3/4" NPT inlet and 3/8" NPT outlet. Equal to Bell & Gossett model No. 107A. Provide ball valve for each vent. Pipe outlet to nearest drain point with 1/8" inside diameter copper tube.

2.5 Strainers

- A. All water lines - Sarco style IF-125 (flanged) or IT (threaded) 125 psig, Y-pattern, cast iron body with perforated brass screen for water. Threaded for 2-1/2" and smaller, flanged for 3" and larger.
- B. Provide basket strainers for condenser water pumps and for sand filter as shown on drawings. Sarco model 734 carbon steel flanged 150 psig.
- C. Dunham-Bush, Armstrong, Trane, McAlear, Mueller, Metraflex, Wheatley or V. D. Anderson strainers may be furnished at the Contractor's option.

2.6 Flexible Vibration Joints shall be selected from the following types, subject to the limitations listed:

- A. Type 1 - Corrugated copper or stainless steel bellows connectors shall be constructed with a woven flexible bronze wire reinforcing protective jacket (4" and larger may be galvanized steel braid) constructed for not less than 125 lb. working pressure. Connectors shall be of sufficient length to allow for 1/2" misalignment of piping and shall have flanged ends except 2" and smaller may be screwed. Connectors shall be Metraflex, Flexconics Corp., Anaconda, Vibration Mountings Inc., Twin City Hose.
- B. Type 2 - Reinforced Teflon molded bellows connectors shall have drilled ductile iron flanges, metal reinforcing rings and limit rods with isolating grommets and shall be of sufficient length and number of bellow to allow for 1/2" lateral misalignment of piping and constructed for not less than 125 pound working pressure. These connectors shall be Metraflex, Vibration Mountings Inc., Use of this type of connection shall be subject to the temperature pressure limitation and shall be governed by manufacturers published data and recommendations.
- C. Furnish with full faced flanges with matching welding type companion flanges. Connections to be bolted.
- D. Temperature rating shall be suitable for service.
- E. Include torque requirement for flange bolts in submittal data.

### **PART 3 EXECUTION**

- 3.1 All specialties to be installed in accordance with manufacturer's recommendations.
- 3.2 Flexible vibration joints to be installed within tolerances specified by manufacturer.
- 3.3 Remove the start up strainer from suction diffusers after pumps are operational and systems has been chemically treated.

### **END OF SECTION**

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## **SECTION 23 05 20 - PAINTING**

### **PART 1 GENERAL**

#### 1.1 REFERENCE

- A. Section 23 05 53 - TAGGING AND CODING

#### 1.2 SCOPE

- A. All steel supports shall have minimum one (1) coat of metal primer after fabrication.
- B. All steel supports mounted outdoors shall have minimum one (1) coat of metal primer and one finish coat of paint after fabrication.
- C. Factory finished equipment which has rusted or been damaged shall be cleaned at the completion of the project and rust spots and marred areas shall be refinished and restored to the original factory finish.
- D. Existing equipment being reused that has rusted shall be cleaned and repainted prior covering with insulation.

### **PART 2 PRODUCTS**

- 2.1 Paint shall meet requirements of Division 9 - Finishes

### **PART 3 EXECUTION**

Not Applicable

### **END OF SECTION**

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## **SECTION 23 05 21 - CUTTING AND PATCHING**

### **PART 1 GENERAL**

Not Applicable

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.1 Cutting for openings, when necessary, shall be done by the HVAC Contractor with such tools and methods as to prevent unnecessary damage to surrounding areas or equipment.
- 3.2 The corners of all openings in poured concrete shall be core drilled to minimize overcutting.
- 3.3 Fill space in all areas where core drilled with packing where required to maintain fire rating. Openings shall be temporarily fire-stopped until permanent fire stopping is done. This includes holes left due to removal of piping or ductwork.
- 3.4 All holes cut for the installation of piping, ductwork and equipment shall be neatly patched and refinished with the same materials as, and to match, adjacent surfaces, and damages thereto shall be repaired in kind and to match existing conditions by this Contractor. This includes patching existing ceilings and floors where required and patching holes left by removal of existing piping, ductwork, equipment, etc.
- 3.5 Patching shall match existing surfaces in kind and finish (co-ordinate with A/E).
- 3.6 No structural member will be cut into without the expressed permission of A/E.

**END OF SECTION**





## **SECTION 23 05 22 - FOUNDATIONS AND SUPPORTS**

### **PART 1 GENERAL**

#### 1.1 SCOPE

- A. Pads to be provided by the Contractor whose equipment the pad is for. Refer to HVAC Drawings for locations. Exact sizes as determined by this Contractor.
- B. This Contractor shall furnish welded steel frames and supports for all equipment requiring same. Furnish auxiliary steel as required for supporting pipes.

### **PART 2 PRODUCTS**

- 2.1 All steel for frames and supports shall be standard weight black steel pipe or standard structural steel shapes. All steel supports located outdoors or exposed to moisture shall be galvanized.
- 2.2 Concrete housekeeping pads for equipment shall be 5 ½ " high typical. Concrete for pads shall be a minimum of 6 bag mix per cubic yard with maximum slump of 4" and shall be air entrained 5 to 7% by volume. Concrete shall be welded wire mesh reinforced. Pads shall have chamfered edges.

### **PART 3 EXECUTION**

- 3.1 Grind all sharp corners and projections on supporting steel after fabrication. All steel shall have one (1) coat of metal primer after fabrication.
- 3.2 All steel supports exposed to the weather shall be galvanized.

### **END OF SECTION**

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## SECTION 23 05 23 - VALVES

### PART 1 GENERAL

#### 1.1 SCOPE

- A. Furnish and install all necessary valves for piping systems and equipment in the building required to provide proper shut off and balancing of systems included under this Contract.
- B. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.
- C. Valves and materials shall comply with applicable standards and specification of ANSI, ASTM, ASME and MSS. Working pressure and temperature ratings of each valve shall exceed those imposed by the service in which it is applied. The following standards shall apply:
  - 1. NSF 61: Valves for potable-water service
  - 2. MSS SP-70-90 Cast Iron Gate Valves, Flanged or Threaded Ends.
  - 3. MSS SP-80-87 Bronze Gate, Globe and Check Valves.
  - 4. MSS SP-85-85 Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.
  - 5. ANSI B16.34, MSS SP-110-92 Ball Valves Threaded, Socket-Welded, Solder Joint, Grooved and Flared Ends.
  - 6. ANSI B16.10, MSS SP-67-90 Butterfly Valves

### PART 2 PRODUCTS

- 2.1 Check valves and gate valves shall be Nibco, Grinnell, Milwaukee, Hammond, Stockham, Watts, Kitz, Powell, Crane or Titan and shall all be by the same manufacturer.
- 2.2 Ball valves shall be as manufactured by Nibco, Grinnell, Stockham, Milwaukee, Hammond, Watts, Kitz, Crane, Marwin, or any of the manufacturer's listed herein for gate, globe and check valves. All ball valves to be by the same manufacturer.
- 2.3 Globe valves shall be as manufactured by Nibco, Grinnell, Milwaukee, Hammond, Stockham, Watts, Kitz, Powell, Crane, or any of the manufacturer's listed herein for globe and check valves.
- 2.4 Butterfly valves shall be as manufactured by Nibco, Stockham, Centerline, Crane, Milwaukee, Hammond, Watts, Keystone, Kitz, Mueller, Bray, Grinnell, or any of the manufacturer's listed herein for gate, globe and check valves. All butterfly valves to be by the same manufacturer.
- 2.5 Ball Valves
  - A. Ball valves shall be used for hot water and chilled water service 3" and smaller.
  - B. 2" size and smaller may be two-piece bronze body ball valve, screwed piping connections, full port, teflon seats, blowout proof stem, adjustable packing gland, stainless steel ball, and lever handle labeled for service controlled. Rated for 150 S.W.P. and 600 WOG. Equal to Milwaukee BA-400S.

- C. 2-1/2" size through 8" size shall be flanged ball valves with A536 ductile iron body and cap, stainless steel ball and stem, carbon steel studs. Equal to American 4000D.

#### 2.6 Butterfly Valves

- A. 3" and larger shall be cast or ductile iron valve. Furnish with lug pattern body, aluminum bronze disc, stainless steel stem, EPDM seat, extended neck for full 2" insulation, and positive shut off at 175 psig W.O.G. (2-12") and 150 psi W.O.G. (14"-20"). Equal to Keystone Fig. AR-2.
- B. 5" and smaller shall have minimum 10 position lever actuators, with positive latching and position indicator. Valves 6" and larger shall have worm gear actuator. Valves shown with chain to be chain operated.
- C. Valves used on outlets of devices for balance purposes shall have an adjustable memory stop (position lock). A notched operator by itself is not considered a memory stop.
- D. Shut off valves in steam pressure reducing station and HX control valve stations to be high performance butterfly valves rated 250 psig for HPS and 125 psig for LPS piping. Equal to Keystone K-LOK series 36/37.

#### 2.7 Gate Valves

- A. Valves in water lines 2-1/2" and larger - iron body, bronze mounted, O.S.&Y., flanged, taper solid wedge disc, rising stem, 125 lb. S.W.P.
- B. Valves in water lines 2" and smaller - all bronze, screwed, taper solid wedge disc, union bonnet, rising stem, 150 lb. S.W.P., industrial grade.
- C. Valves in high pressure steam shall be cast steel body, class 300 psig, Crane fig 33 or equal.

2.8 Drain valves shall be ball valves as specified above with hose nipple and cap.

#### 2.9 Globe Valves

- A. Accepted Manufacturers:
  - 1. 2" and Smaller: Crane, Grinnell, Hammond, Jenkins, Nibco, Stockham.
- B. Globe Valve, 2 in. and smaller. Nibco T-235-Y, 150 w.s.p., bronze body, screwed ends, rising stem, union bonnet, bronze seat and TFE disc.
- C. Globe Valve, 2.50 in. and larger. Nibco F-718-B, 125 w.s.p., iron body bronze trim, flanged ends, renewable bronze seat and disc.

#### 2.10 Check Valves

- A. Accepted Manufacturers:
  - 1. 2" and Smaller: Crane, Grinnell, Hammond, Jenkins, Nibco, Stockham.
- B. 3" and larger - iron body, bronze mounted, horizontal swing check with bronze disc, flanged, 125 lb. S.W.P.

- C. 2-1/2" and smaller - all bronze, horizontal swing check with bronze or TFE disc, screwed, 125 lb. S.W.P.
  - D. Non-slam, silent check valves shall have an in-line spring loaded design with cast iron body and stainless steel seat, disc, spring, bushing, and screw.
    - 1. 2" size shall be equal to Milwaukee 1400 series.
    - 2. 2-1/2" and larger shall be equal to Milwaukee 1800 series.
  - E. Clow, McAlear, Mueller or Metraflex non-slam check valves are acceptable manufacturers as well as previously listed manufacturers.
- 2.10 Combination Balance and Stop Valve
- A. Bell and Gossett "Circuit Setter Plus", bronze body, screwed combination balance and stop ball valve. 2½" and smaller screwed. 3" and larger flanged. Valves to have readout ports, 1/4" drain port, memory stop indicator, calibrated nameplate, 300 lb. W.O.G. Valves shall be designed for a pressure drop of 2 to 5 feet head.
  - B. A molded polyurethane container shall be provided with each valve on cold services, to be utilized as an insulating cover.
  - C. Same type Illinois, Spirax Sarco, Flow Design, Taco or Tour & Anderson stop and balance valves may be furnished at the Contractor's option.

### **PART 3 EXECUTION**

- 3.1 This Contractor shall install all valves in strict accordance to the manufacturer's recommendations.
- 3.2 Where the Drawings call for a balance valve or fitting, the Contractor may, at his option, furnish a combination balance and stop valve, however a ball valve or butterfly valve shut off must be provided for isolation. The use of combination balance and shut off valves for isolation is prohibited.
- 3.3 Where drain lines are not piped to floor drains, furnish hose end adapters. Provide caps for all hose end adapters.
- 3.4 Ball valves and butterfly valves designated with an "M" shall be furnished with memory stops.
- 3.5 This Contractor shall remove the start-up strainer from suction diffusers after pumps are operational and system has been chemically treated.
- 3.6 Valves shall be installed with the stem at or above the centerline of the pipe. Valves shall be located to be accessible for operation, servicing and/or removal.
- 3.7 Internals shall be removed and the remaining elements of sweat end valves shall be protected against heat damage during soldering or brazing.
- 3.8 Packing glands shall be tightened before placing the valves in service.
- 3.9 Butterfly valves and ball valves in piping which is to be insulated shall have extended shaft necks to accommodate the insulation.

3.10 Remove the start-up strainer from suction diffusers after pumps are operational and system has been chemically treated.

3.11 The use of solder connection on valves is expressly prohibited.

**END OF SECTION**

## SECTION 23 05 29 - INSERTS, PIPE HANGERS AND SUPPORTS

### PART 1 GENERAL

#### 1.1 SCOPE

- A. Furnish and install all necessary inserts, beam clamps and auxiliary steel for pipe hangers in the building.
- B. Furnish and install necessary pipe hangers and supports to properly support all piping and to maintain uniform elevation.

### PART 2 PRODUCTS

#### 2.1 HANGERS

- A. Hangers for copper lines, 2" and smaller, shall be similar to Grinnell Fig. CT-99, adjustable carbon steel pipe ring, with 3/8" hanger rods. All copper plated.
  - B. Hangers for copper lines 2-1/2" to 4" shall be similar to Grinnell Fig. CT-65, adjustable carbon steel clevis, with proper size rods, all copper plated. Unplated clevis may be used if full round lead sleeves 2" wider than the clevis are secured to the pipe at each hanger.
  - C. When copper lines are insulated and hangers are sized for outside of insulation, provide steel hangers as described below.
  - D. Hangers for steel lines 2" and smaller shall be similar to Grinnell Fig. 97, adjustable pipe ring, galvanized steel band with 3/8" hanger rods.
  - E. Hangers for steel lines 2-1/2" and larger shall be similar to Grinnell Fig. 260, adjustable carbon steel clevis, heavy duty, with proper size rods.
  - F. Hangers for high and medium pressure steam lines, chilled water and make-up lines 1-1/4" and larger shall be sized for outer diameter of insulation. Furnish 1/2 round galvanized sheet metal insulation protectors minimum 12" long similar to Grinnell Fig. 167 on bottom half of insulation for chilled water and make-up water lines 1-1/4" and larger at each pipe hanger.
- 2.2 B-Line, F & S, Elcen, Penn, Fee-Mason, PHD Manufacturing or Modern Pipe Hangers of the same type may be furnished at the Contractor's option.

### PART 3 EXECUTION

- 3.1 Riser clamps shall be used at each floor where required.
- 3.2 Wall bracket pipe supports shall be installed where required.
- 3.3 All copper piping is to be shielded from steel pipes or electrical conduit with sheet lead or electrical tape wherever pipes would touch each other.
- 3.4 Galvanized hangers and strap hangers will not be permitted for supporting copper lines except for hangers sized for outside of insulation.

- 3.5 Provide pipe anchors and guides where and as indicated on the Drawings and elsewhere as required to properly control pipe. Method to suit job conditions.
- 3.6 Support piping at pumps and equipment from floor, ceiling, or walls, so that piping weight is not supported directly from pumps or equipment.
- 3.7 All beam clamps and supports for piping and ductwork shall be in place prior to the fireproofing of the structural steel.
- 3.8 Piping to be supported according to the following schedule. Support at intervals not to exceed spacing listed or elsewhere as required in accordance with good workmanship. No pipe shall be supported from another pipe. All hangers shall be plumbed before insulation is applied and all hangers shall be double nutted.

		<u>SPACING</u>			
<u>(1) Steel Pipe</u>				<u>(2) Copper Pipe</u>	
<u>Pipe Size</u>	<u>Rod</u>	<u>Spacing</u>		<u>Pipe Size</u>	<u>Spacing</u>
Thru 1"	3/8"	7'0"		Thru 3/4"	6'0"
1-1/4"	3/8"	9'0"		1"	7'0"
1-1/2"	3/8"	9'0"		1-1/4"	9'0"
2"	3/8"	10'0"		2"	9'0"
2-1/2"	1/2"	11'0"		2-1/2"	11'0"
3"	1/2"	12'0"		3"	11'0"
4"	5/8"	14'0"		4"	11'0"
6"	3/4"	17'0"		6"	14'0"
8"	7/8"	19'0"			

**END OF SECTION**



## **SECTION 23 05 30 - INSTALLATION OF PIPING**

### **PART 1 GENERAL**

#### **1.1 REFERENCE**

- A. Section 23 05 19 - PIPING SPECIALTIES
- B. Section 23 05 23 - VALVES
- C. Section 23 05 29 - INSERTS, PIPE HANGERS AND SUPPORTS
- D. Section 23 05 93 - TESTS AND ADJUSTMENTS

#### **1.2 SCOPE**

- A. The requirements of this Section shall apply to all interior piping systems installed under this Contract, except where otherwise noted on the Drawings or elsewhere in the Specifications.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

- 3.1 All piping systems shall be installed with adequate provisions made for expansion and contraction to prevent stresses on piping, valves and equipment. Anchor and guide piping at all points indicated and/or as required. Type and method of anchoring, guiding and attachments to sustaining members to suit job requirements and conditions and shall be approved by the University.
- 3.2 Provide flanges or unions at each screwed valve, final connection, and at each piece of equipment. Branches from mains to equipment stubs, risers, etc., to have swing joints with at least one change of direction in the horizontal plane, and one change of direction in the vertical plane, before connecting to equipment or fixtures. Piping shall be arranged and unions and flanges located to permit easy removal of valves, parts, and equipment for inspection and cleaning without disconnecting any part except unions or flanges. No welded connections shall be made to valves or equipment. Use bronze unions in copper lines. Unions to be downstream of valves. Dielectric unions shall not be used per Ohio University Design and Construction Standards. For dielectric isolation of valves, use threaded bronze body valve and bronze nipples on both sides. Place unions on both sides.
- 3.3 Flange bolts shall be cut to proper length so that one thread projects beyond the nut when nut and bolt are tightened.
- 3.4 Make proper connections to all items of equipment in the Contract as recommended by the Manufacturer or as detailed on the Drawings.
- 3.5 All piping shall be arranged in accordance with the best standards of the trade with vertical pipes plumb and horizontal runs parallel or perpendicular to the building wall.
- 3.6 Provide valves and specialties where indicated on the Drawings.
- 3.7 Provide 3/4" drain valves in piping at low points to provide complete drainage of all systems and as shown on the Drawings.
- 3.8 Ream ends of pipe and clean before installing.

- 3.9 All joints in copper piping shall be made with 95-5 solder. Solders and fluxes containing lead are prohibited. The use of solder connections at valves is expressly prohibited.
- 3.10 Use pipe dope on male threads of screwed pipe only. Teflon pipe joint tape may be used, at the Contractor's option.
- 3.11 Valves to be installed with handwheel at or above center of pipe. Valves outdoors exposed to weather shall be installed with handwheel in the horizontal.
- 3.12 Make all changes of direction with fittings, rather than bending.
- 3.13 All valves and unions to be installed so as to be accessible through ceiling, access panels, etc.
- 3.14 Provide dielectric bronze nipples or insulating flanges between dissimilar metals, i.e., copper to steel.
- 3.15 Bull head connections in any piping service are expressly prohibited.
- 3.16 At the end of each day's work and otherwise as required or directed, provide caps and/or plugs at all openings in piping for protection. Particular attention must be given to avoid the possibility of any foreign materials entering the pipes, whether it be inadvertent or with malicious intent.
- 3.17 Flanged joints shall be faced true and square. Flanges shall be same face style as mating surface to which it is connected.
- 3.18 Install thermometers and gauges so they may be read from floor level.
- 3.19 Install Pete's Plugs as close as possible to control valves, coils, etc. and arranged so that a probe may be inserted into the plug.
- 3.20 Where piping is installed in accessible chases, keep all piping to sides of chase, except portions which must necessarily be in center of chase. Offset vents to side immediately above connection to waste line. All lateral runs are to be located at the floor or minimum 6'-0" above floor, and all vertical piping held close to the wall through that height leaving maximum service space.
- 3.21 Install galvanized sheet metal troughs with drains under pipes crossing electrical equipment. Seal to make water tight.
- 3.22 Do not run water or steam piping through electrical rooms.
- 3.23 Properly support all relief valve discharge piping and provide no more than one 90° ell.

**END OF SECTION**

## SECTION 23 05 48 - EXPANSION AND VIBRATION

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Section 23 05 30 - INSTALLATION OF PIPING
- B. Section 23 21 13.13 - CHILLED WATER PIPING SYSTEM
- C. Section 23 21 13.23 - HOT WATER HEATING PIPING SYSTEM
- D. Section 23 21 23.16 - END SUCTION PUMPS
- E. Section 23 82 19 - FAN COIL UNITS
- F. Section 23 75 00 - AIR HANDLING UNITS

#### 1.2 SCOPE

- A. Materials furnished under Division 23 to be installed with all necessary expansion compensation, otherwise build in means of expansion compensation during construction.
- B. Motorized or vibrating equipment must be isolated from supports or connections to prevent transmission of vibration or generation of sound.
- C. All piping connected to reciprocating or rotating equipment shall be isolated with flexible connectors within five (5) feet of the equipment.
- D. Furnish and install a complete vibration isolation system to isolate all mechanical equipment and all piping and appurtenances within 10 ft. of the equipment, from the Building structure. All mechanical equipment, including all fans and all other equipment as scheduled on the Drawings, shall be mounted on or suspended with vibration isolators.
- E. Include Vibration Rating Data for each vibration rated isolator or restraint component.
- F. Submit shop drawings for all devices specified herein. Submittals shall indicate full compliance with the device specification in Part 2. Any deviation shall be specifically noted and subject to engineer approval. Submittals shall include device dimensions, placement, attachments and anchorage requirements. Shop Drawings shall include the following:
  - 1. Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment, if needed or required. Include auxiliary motor slides and rails, base weights, equipment static loads.
  - 2. Vibration Restraint Details: Detailed submittal drawings of vibration restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Include ratings for loads.
  - 3. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- G. The materials and systems specified in this section shall be purchased by the Contractor from a single vibration isolation / snubber restraint materials manufacturer to assure sole source responsibility for the performance of the vibration support system used. The materials and systems specified in this section can, at the Contractor's option, be installed by the Contractor who installs the mechanical equipment, piping, or ductwork.

## **PART 2 PRODUCTS**

- 2.1 All vibration isolator mounts, hangers and bases are based on those manufactured by Kinetics Corporation.
- 2.2 Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have  $k_x/k_y$  ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.
- 2.3 Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as indicated on the Schedule.
- 2.4 H" Mounts - Combination spring and fiberglass isolation "Hangers", incorporating 2" thick neoprene jacketed fiberglass inserts in series with spring, all encased in welded steel brackets. Minimum static deflection shall be as tabulated on the Drawings, and the spring shall have a minimum additional travel of 50 percent between the design height and the solid height. The hangers shall be type SFH.
- 2.5 "S" Mounts - Free standing, unhoused stable "Spring" mounts, incorporating leveling bolts, and a means of bolting to the supporting unit. Minimum static deflection shall be as tabulated on the Drawings. Mounts shall have 1/4" neoprene jacketed fiberglass noise isolation pads bonded to the bottom of the spring mounts. To assure stability, the minimum outside spring diameter shall be as tabulated below, and the springs shall have a minimum additional travel of 50 percent between the design height and the solid height. Mounts shall be type FDS.
- 2.6 The isolator manufacturer's submittal shall include the complete design for the supplementary bases, a tabulation of the design data on the isolators, including O.D., free, operating and solid heights of the springs, free and operating heights of the neoprene or fiberglass isolators, and isolation efficiency based on the lowest operating speed of the equipment supported.
- 2.7 Vibration isolation equipment by Korfund Dynamics Corp., Mason Industries or Vibration Mountings and Controls, Inc. of the same type and capacity may be furnished at the Contractor's option. All isolation mountings shall be by the same manufacturer.

## **PART 3 EXECUTION**

- 3.1 Install piping to permit free expansion and contraction without damage to joints and hangers.
- 3.2 Provide securely supported pipe anchors and guides where required or necessary to control expansion and contraction of piping. Method to suit job conditions.
- 3.3 Install flexible connections in all duct connections to all fans and fan coil units.
- 3.4 Install flexible connections in piping to motorized equipment which is otherwise isolated.
- 3.5 Installation of all vibration isolation materials and supplemental equipment bases specified in this section shall be accomplished as per the manufacturer's written instructions and adjust mountings to level equipment.
- 3.6 On completion of installation (as per KNC provided installation documents) of all isolation materials and before startup of isolated equipment all debris shall be cleared from areas surrounding and from beneath all isolated equipment, leaving equipment free to move on the isolation supports.

- 3.7 No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated equipment.
- 3.8 Ensure pipe, duct and electrical connections to isolated equipment do not reduce system flexibility. Ensure that pipe, conduit and duct passing through walls and floors do not transmit vibrations.
- 3.9 Unless indicated otherwise, piping connected to isolated equipment shall be isolated as follows:
- A. Up to (NPS) 4" Diameter: first 3 points of support. (NPS) 5" Diameter to (NPS) 8" Diameter: first 4 points of support. (NPS) 10" Diameter and Over: first 6 points of support.
  - B. First point of support shall have a static deflection equal to the deflection of isolated equipment; with a maximum of 2" (50 mm). Subsequent support points shall have a static deflection no less than 1" (25mm).
  - C. Deflection shall be not less than that for the equipment to which the piping is connected.
  - D. Block and shim level bases so that the ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.
- 3.10 VIBRATION ISOLATION INSPECTION
- A. The Contractor shall notify the local representative of the vibration isolation materials manufacturer prior to installing any vibration isolation devices. The Contractor shall seek the representative's guidance in any installation procedures with which he is unfamiliar.
  - B. The local representative of the vibration isolation materials manufacturer shall conduct periodic inspections of the installation of materials herein specified, and shall report in writing to the Contractor any deviations from good installation practice observed.
  - C. On completion of installation of all noise and vibration isolation devices herein specified, the local representative of the isolation materials manufacturer shall (only upon request as required) inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other fault in the system that could affect the performance of the system.

**END OF SECTION**



## **SECTION 23 05 53 - TAGGING AND CODING**

### **PART 1 GENERAL**

#### **1.1 SCOPE**

- A. Furnish and install pipe markings, equipment labels and valve tags as described below.
- B. Each item of major equipment shall be labeled including, pumps, air handling units, fans, VAV boxes, fan coil units and other similar equipment.
- C. Pipe markings shall be applied to all piping and duct markings shall be applied to all ductwork.
- D. Each shutoff valve, other than at equipment, shall be identified with a stamped tag. Valves and tagging shall be scheduled typewritten on letter-sized paper (8.5 inches by 11 inches), tabulating valve number, piping system, system abbreviation, location of valve (room or area) and service.

### **PART 2 PRODUCTS**

#### **2.1 MATERIALS**

- A. Snap around pipe markers.
- B. Tags shall be non-ferrous metal with number and service abbreviation engraved in the tag.

### **PART 3 EXECUTION**

#### **3.1 EQUIPMENT**

- A. Each major piece of equipment furnished shall be labeled by means of 2" high stenciled, painted lettering, and by a permanent metal tag fastened to the unit. The stamped marking shall be permanent on the metal tag.
- B. Labeling shall consist of the unit designation as shown on the drawings and in addition, labeling shall indicate the rooms or areas being served. Room numbers shall be from the existing building numbering system.
- C. Insure that nameplates are provided in readable locations. If they are not, they shall be removed and replaced in a visible location.

#### **3.2 PIPE MARKINGS**

- A. Markings shall be applied to all new piping after installation, insulation and final painting. Markings shall consist of 1" high black letters, a color coded band and a direction arrow. Markers shall be placed at 25 foot centers on both exposed and concealed piping. Painting letters by use of stencils is acceptable. Color code shall match the existing building standard.

#### **3.3 VALVE TAGS**

- A. Each valve, including those installed adjacent to equipment for isolation of that item, shall be identified with a stamped aluminum or brass tag attached with a brass "S" hook or flexible metal wire. A printed schedule shall be prepared and framed under clear plastic or glass describing each valve by consecutive number, location and service for which used. On renovation work, begin new numbering with the last number used in the existing sequence. Two additional unframed copies shall be furnished, all being turned over to the A/E with a letter of transmittal. Copies shall also be included in the Owner's Maintenance manual.
- B. Valves and tagging shall be scheduled typewritten on letter-sized paper (8.5 inches by 11 inches), tabulating valve number, piping system, system abbreviation, location of valve (room or area) and service.

**END OF SECTION**



**SECTION 23 05 93 - TESTS AND ADJUSTMENTS**

**PART 1 GENERAL**

1.1 SCOPE

- A. After work has been completed but before pipe covering has been applied, the Contractor shall test and adjust the systems he has installed.
- B. The University and the A/E shall be notified of all scheduled tests and adjustments at least 48 hours before they are scheduled so that he may witness same. If the Contractor performs any test or adjustment without the A/E present or without properly notifying the A/E, the Contractor will be required to perform the test or adjustment a second time in the presence of the A/E.
- C. If the University or the A/E determines that any work requires special inspection, testing, or approval, they will, upon written authorization, instruct the Contractor to order such special inspection, testing or approval. The Contractor shall give timely notice so the A/E may observe the inspections, tests or approvals. If such special inspection or testing reveals a failure of the work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the A/E's additional services made necessary by such failure.
- D. Concealed lines shall be tested before being concealed. If this is not done and a leak appears during the final test, this Contractor shall repair leak and all damage resulting therefrom.
- E. This Contractor shall adjust all his equipment in the mechanical system to obtain proper operation and shall demonstrate to the University and the A/E that the entire system will function properly.

**PART 2 PRODUCTS**

Not Applicable

**PART 3 EXECUTION**

- 3.1 After work has been completed but before pipe covering has been applied, the Contractor shall test the systems as follows. At these pressures, the circulation shall be free and the piping free of leaks.

System	Test Medium	Pressure Not Less Than	Time Not Less Than	Notes
Make-up Water Lines	Water	125 lbs	24 hrs	no drop
Heating Water	Water	125 lbs	24 hrs	no drop
Chilled Water Lines	Water	125 lbs	24 hrs	no drop
Condenser Water Lines	Water	125 lbs	24 hrs	no drop

- 3.2 Testing High Pressure Ductwork and System:

- A. Each duct system shall be tested for air tightness by use of a small blower, water manometer and calibrated orifice.
- B. Test pressure shall be 6" wc.

- C. Air leakage loss indicated by the calibrated orifice shall not exceed one (1) percent of the total air handled by the particular system of section of system under test.
- D. Allowable duct leakage shall not be confined to any one section of a system because of objectionable noise generation and concentration.
- E. Before final connections to high velocity boxes are made with flex duct, the entire system shall be cleaned out and blown out.
- F. The A/E's representative shall be notified, so that he may witness all tests.

3.3 Balancing Air and Water Systems:

- A. The Contractor shall procure the services of an independent company which specializes in the testing and balancing of air and water systems. All balancing work shall be done under the direct supervision of a qualified Heating and Ventilating Engineer. It shall be the responsibility of this Contractor to make all necessary arrangements with the Balancing Company for balancing the air and water systems after all equipment, ductwork, outlets, piping and accessories have been installed. A detailed report on all balancing work shall be prepared and submitted, in triplicate, to the A/E for review. Each copy of the report shall be dated, signed by the supervising Engineer of the Balancing Company and bound in a suitable cover. The Balancing Company shall be selected by the Contractor from the following qualified firms:
  - 1. Kahoe Air Balance Company
  - 2. Any member of the Associated Air Balance Council
  - 3. Any member of the NEBB
- B. Balancing procedures and report to be in accordance with procedures set forth by the Associated Air Balance Council. Report shall also include pump and fan curves and their operating points. Written procedures for balancing each piece of equipment is required.
- C. Where Pete's Plugs are installed, report shall include pressure drop readings across coils, control valves (Cv), etc., to confirm flow rates.
- D. Balance reports shall include starter element sizes, and amperage ratings for each motor. If starter elements amperage rating is more than 10 percent greater or less than motor nameplate amperage, this Contractor shall inform the Electrical Contractor to furnish and install proper size elements. Balance report shall include the corrected proper size starter element sizes and amperage ratings.
- E. Balance Subcontractor shall report by letter to the A/E on preliminary results of balancing before the final balance report is prepared. This report shall include any problems encountered during balancing or major deviations from specified conditions.
- F. If required, a meeting shall be arranged between this Contractor, the Balance Subcontractor and the A/E to resolve any problems or deviations from the Contract Drawings and Specifications before the final balance work is completed and final report is submitted for review by the A/E.

3.4 All dampers, damper operators and motor operated valves shall be checked and adjusted for proper operation and travel.

3.5 Before turning job over to the University, inspect all valves and repack valves as necessary.

- 3.6 Adjust pattern controllers on all linear supply air diffusers. Diffusers located at perimeter glazing shall be initially set to vertical throw. Diffusers located away from perimeter walls shall be initially set to horizontal throw.
- 3.7 This Contractor shall adjust all equipment in the mechanical system to obtain proper operation and shall demonstrate to the University and the A/E that the entire system will function properly.
- 3.8 All new fire dampers and fire and smoke dampers shall be tested in the presence of the A/E and University after installation. Furnish additional links as needed.

**END OF SECTION**

## SECTION 23 05 94 - PROTECTION AND CLEANING

### PART 1 GENERAL

Not Applicable

### PART 2 PRODUCTS

Not Applicable

### PART 3 EXECUTION

- 3.1 Protect all mechanical equipment against damage from any cause whatsoever and pay the cost of replacing and repairing equipment made necessary by failure to provide suitable protection.
- 3.2 After all piping, equipment and ductwork has been approved and after all plastering has been completed, bare piping and insulation provided under this Contract shall be thoroughly cleaned of dirt, grease, rust and oil.
- 3.3 Repair all dents and scratches in factory prime or finish coats on all mechanical equipment to the satisfaction of A/E. If damage is excessive, replacement may be required.
- 3.4 Flush out all piping systems to remove all dirt and grease from pipes and equipment before systems are placed in operation. Clean strainers after each flushing until the strainer remains clean. Flushing shall create a velocity of no lower than 4.0 feet per second.
- 3.5 The Contractor shall clean all water piping systems under this Contract. After systems have been flushed thoroughly and drained, clean as follows:
  - A. Completely fill, air vent, and circulate systems for four (4) hours at design temperatures with the following solution:

One pound of trisodium phosphate for each 50 gallons of water or one pound of sodium carbonate for each 30 gallons of water.
  - B. Completely drain and refill with fresh clear water.
  - C. After venting and circulating, check pH.
  - D. If system pH is below 7, add small amounts of cleaner until pH is between 7 and 8.
  - E. The utility chilled water supply and return must be cleaned and flushed separately before opening to the building piping system to clean out both the new utility lines and the existing steam line being reused. This Contractor shall provide temporary piping, valves, temporary power and circulating pump to circulate the cleaning solution through the piping. The utility piping cannot be opened to the building piping until the cleaning and flushing is approved by University Facilities.
- 3.6 Ductwork and air handling equipment is to be cleaned out and blown out.

- 3.7 If heating units are operated for temporary heat during construction, this Contractor shall replace all throwaway and prefilter type filters before the building is turned over to the Owner. Filters must be in units at any time fans are operated.
- A. If high efficiency filters are used, they shall be cleaned to the satisfaction of A/E or if pressure drop indicates they are more than 1/3 dirty, they shall be replaced.
- 3.8 Cover all motors, fans, pumps, open pipes, open ductwork, etc., to keep out dirt, water and weather during construction.
- 3.9 This Contractor shall clean up and remove all debris from the site and shall at all times keep the premises in a neat and orderly condition.

**END OF SECTION**

## **SECTION 23 05 96 - SUBSTITUTIONS**

### **PART 1 GENERAL**

#### **1.1 REFERENCE**

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

#### **1.2 SCOPE**

- A. The Base Bid shall be based on equipment as specified. Where items are mentioned thusly, "may be furnished at the Contractor's option", the Contractor may use any one of the items named for his Base Bid. Proposals for substitutions are welcomed, but must be noted separately from the Base Bid and applied for in writing at Bid submittal.
- B. Where the Contractor furnishes equipment or material specified as equal, he is responsible for all modifications required for his work, and work of all other trades to install the equipment and insure performance as originally specified.
- C. Equipment and materials furnished as equal or as a substitution must be equal in quality, design, features, performances, arrangement, and appearance to that specified as standard.

- 1.2 Read instruction to Bidders and General and Special Conditions for requirements for substitutions.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

Not Applicable

**END OF SECTION**

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CONSTRUCTION DOCUMENTS  
SEPTEMBER 9, 2024  
OU PROJECT 23002

## SECTION 23 07 00 - HVAC INSULATION

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Section 23 01 00 - Paragraph 1.5 OHIO ENERGY CODE.
- B. Section 23 21 13.13 - CHILLED WATER PIPING SYSTEM
- C. Section 23 21 13.23 - HOT WATER HEATING PIPING SYSTEM
- D. Section 23 21 13.33 - CONDENSATION DRAIN AND DRAIN PIPING SYSTEM
- E. Section 23 22 13 - LOW PRESSURE STEAM AND CONDENSATE PIPING
- F. Section 23

#### 1.2 SCOPE

- A. Extent of Work - Insulate pipes and other surfaces as follows:

Chilled Water Piping  
Hot Water Heating Piping  
Supply Air, Mixed Air and Outside Air Ducts  
Condensation Drain Lines  
Chiller Water Headers, Miscellaneous Piping and Appurtenances  
Refrigerant Piping  
Control valves  
Heat exchangers  
Steam and Condensate Piping

### PART 2 PRODUCTS

- 2.1 All insulating materials, including jackets, cements, adhesives, vapor barriers, etc., shall be U.L. listed with a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50.
- 2.2 Molded plastic fitting covers shall be U.L. approved with a flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50.
- 2.3 Pipe insulation shall be Johns Manville "Micro-Lok" glass fiber insulation rated for 850°F. with factory applied AP-1 all purpose, self-sealing vapor barrier jacket. Butt strips shall be minimum 3" wide of same material as jacket.
  - A. Fiberglass pipe insulation shall be factory molded tubular type with "all service" jacket having an integral vapor barrier. Longitudinal joints of the jacket shall be over-lapping with factory applied adhesive. Butt joints shall be sealed with 3 in. wide ASJ pressure sensitive tape. Insulation shall be GreenGuard Certified for low formaldehyde and VOC emissions.
- 2.4 Insulation for chilled water pump casings and plate heat exchangers shall be 25/50 rated flexible closed cell, elastomeric Armstrong Armaflex II sheet and roll insulation, rated for -40°F to 220°F.
- 2.5 Duct insulation shall be Johns Manville rigid type as noted with FSK glass fiber reinforced foil faced flame resistant kraft paper vapor barrier facing.
- 2.6 All fiberglass cover above shall be by Johns Manville. Equivalent type thickness and conductivity insulation by Owens Corning, Knauf, or CertainTeed meeting all requirements may be furnished at the CM's option.



- 2.7 All elastomeric cover above shall be by Armstrong. Equivalent type thickness and conductivity insulation by Aerotube, Halstead, Imcoa or Rubitex meeting all requirements may be furnished at the CM's option.
- 2.8 Insulation thicknesses are based on insulation having thermal resistance in the range of 4.0 Hr F ft.<sup>2</sup>/BTU to 4.6 Hr F ft.<sup>2</sup>/BTU per inch of thickness on a flat surface at a mean temperature of 75°F. Minimum insulation thickness shall be increased for materials having R values less than 4.0 or may be reduced for materials having R values greater than 4.6 to give equivalent "R" values.
- 2.9 All mastics, adhesives, sealers etc, shall have low VOC emittance as required by LEED recommendations.

**PART 3 EXECUTION**

3.1 Insulation Thickness Table

A. In the absence of a specified insulation thickness, the following table shall apply:

MINIMUM PIPE INSULATION  
 INSULATION THICKNESS IN INCHES  
 FOR PIPE SIZES

Piping System Types	Fluid Temperature	Runouts up to 2"*	1" and less	1-1/4 to 2"	2-1/2" to 4"	5" to 6"	8" and Larger #
<b>HEATING SYSTEMS</b>							
Steam and Hot water							
High Pressure	306-450	1-1/2	1-1/2	2	2-1/2	3-1/2	3-1/2
Med Pressure/ Temp	251-305	1-1/2	1-1/2	2	2-1/2	3	3
Low Pressure Temp	201-250	1	1	1-1/2	1-1/2	2	2
Low Temperature	120-200	1	1	1	1	1	1-1/2
<b>COOLING SYSTEMS</b>							
Chilled Water	40-55	1	1	1	1	1	1
Refrigerant suction lines	30-45				1		

\*Runouts not exceeding 12 ft. in length to Individual Terminal Units.

# Chilled water piping in tunnel shall be 2" thickness.

3.2 Cover hot water heating piping, steam and condensate piping as follows:

- A. Cover all piping with glass fiber pipe insulation. Minimum insulation thickness to be as shown in the Table (3.01).
- B. Fittings shall be wrapped with compressed fiberglass to same thickness and density as adjacent pipe insulation and covered with a molded plastic fitting.
- C. All mechanical couplings shall be wrapped with compressed fiberglass to the same thickness as adjacent pipe insulation and covered with a molded plastic fitting.
- D. No covering required on supply and return lines inside heating units cabinets.
- E. Valves, flanges and unions shall not be covered. Insulation shall be stopped square with valves, etc., and ends sealed with Benjamin Foster "Tight Fit" coating.

- F. Finish insulation on all piping in mechanical rooms, tunnels, storage rooms and in exposed locations with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) vapor barrier jacket applied with Foster No. 30-36 and two coats No. 30-42 over glass cloth. In lieu of the glass cloth and mastic specified, a 14.3 oz. rewettable glass cloth equal to Alpha Maritex Style 84217/9485 RW may be used at the Contractor's option.
  - 1). Knauf pipe insulation with an ASJ + jacket or Owens Corning insulation with "Evolution" paper free ASJ may be used in place of the above specified glass cloth.

3.3 Cover all chilled water piping as follows:

- A. Cover all piping with glass fiber pipe insulation. Minimum insulation thickness to be as shown in Table 3.01.
- B. Butt all edges of insulation and seal all longitudinal laps and butt strips with white vapor barrier cement similar to Foster No. 85-20, or factory self-sealing laps.
- C. Fittings shall be wrapped with compressed fiberglass to same thickness and density as adjacent pipe insulation and covered with a molded plastic fitting.
- D. All valves (including bonnet), flanges, unions, etc. shall be covered with full thickness insulation and jacket.
- E. Use 12" long sections of calcium silicate insulation with jacket same as adjacent pipe covering at each hanger. At the Contractor's option, install a treated wood block or high density (20 lb./ft.<sup>3</sup>) fiberglass block at each hanger. Vapor barrier to be maintained throughout.
- F. All mechanical couplings shall be wrapped with compressed fiberglass to the same thickness as adjacent pipe insulation and covered with a molded plastic fitting.
- G. Finish insulation on all piping in mechanical rooms, tunnels, storage rooms and in exposed locations with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) vapor barrier jacket applied with Foster No. 30-36 and two coats No. 30-42 over glass cloth. In lieu of the glass cloth and mastic specified, a 14.3 oz. rewettable glass cloth equal to Alpha Maritex Style 84217/9485 RW may be used at the Contractor's option.
  - 1. Knauf pipe insulation with an ASJ + jacket or Owens Corning insulation with "Evolution" paper free ASJ may be used in place of the above specified glass cloth.
- H. Pipe covering outside of the building shall be same type as above, 2" thick and finished as follows:

Cover insulation with 0.016 embossed aluminum jacket properly installed with sealing compounds, metal band joint straps, etc., to make weathertight. Heat tracing shall be provided on exterior chilled water piping by the Electrical Contractor. Heat tracing must be installed before insulation is applied. Coordinate with Electrical Contractor.

3.4 Cover cold water make-up and condensation drain piping as follows:

- A. Cover all piping with 1/2" thickness glass fiber pipe insulation.
- B. Seal all laps and butt strips with white vapor barrier cement or factory self-sealing laps.

- C. Fittings shall be wrapped with compressed fiberglass to same thickness and density as adjacent pipe insulation and covered with a molded plastic fitting.
- D. All valves (including bonnets), flanges, unions, etc. shall be covered with full thickness insulation and jacket.
- E. Finish insulation on all piping in mechanical rooms, tunnels, storage rooms and in exposed locations with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) vapor barrier jacket applied with Foster No. 30-36 and two coats No. 30-42 over glass cloth.
  - 1). Knauf pipe insulation with an ASJ + and jacket or Owens Corning insulation with "Evolution" paper free ASJ may be used in place of the above specified glass cloth.
- F. Pipe covering outside of the building shall be same type as above, 2" thick and finished as follows:

Cover insulation with 0.016 embossed aluminum jacket properly installed with sealing compounds, metal band joint straps, etc., to make weathertight. Heat tracing shall be provided on exterior chilled water piping by the Electrical Contractor. Heat tracing must be installed before insulation is applied. Coordinate with Electrical Contractor.

3.5 Insulate Steam Piping as follows:

- A. Cover all piping with glass fiber pipe insulation. Minimum insulation thickness to be as shown in Table 3.01.
- B. Fittings for low pressure steam piping shall be wrapped with compressed fiberglass to same thickness as the adjacent pipe insulation and covered with a molded plastic fitting.
- C. Fittings for high pressure steam piping shall be wrapped with compressed fiberglass to same thickness as the adjacent pipe insulation and secured with stretchable glass fabric jacket and adhesive.
- D. Traps, Flanges, PRVs, valve bodies and unions shall be provided with removable insulating jacket suitable for the application. Jackets by Thermaxx Jackets, Spirax Sarco or Advance Thermal Corp.

3.6 Insulate Outside Air Ducts and Plenums as follows:

- A. Insulate outside air ducts and plenums and exhaust air plenums behind louvers and down stream of damper with 2" thick, 6 lb./cu. ft. density rigid duct insulation. Insulation shall be applied with edges tightly butted and secured by impaling on pins welded to the duct or cherry rivet pins. Pins shall be on spacing to hold insulation firmly against duct surface. Speed clips approximately 1-1/2" square shall be pushed over the pins to hold the insulation, after which, the pins shall be clipped off close to the insulation. Insulation may be secured to top of ducts with adhesive.
- B. Seal all breaks and joints in vapor barrier with 2-1/2" wide pressure sensitive tape to match vapor barrier facing. Adhere with Foster's 85-20 adhesive where necessary.
- C. Wrap insulation on all exposed ducts with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) adhered and coated with Foster No. 30-36 coating.
- D. Knauf duct insulation with an ASJ + jacket or Owens Corning insulation with "Evolution" paper free ASJ may be used in place of the above specified rigid insulation with glass cloth.

- 3.7 Cover all high pressure supply air ducts as follows:
- A. All ducts shall be insulated with 1-½" thick, 1 lb. density blanket flexible duct insulation.
  - B. Adhere insulation to duct surface with Foster No 85-20 adhesive applied in 6" wide strips on 12" centers. Butt all edges of insulation and seal all joints with a foil-skrim-kraft tape or flange adhered over the joint. Secure insulation with flare door staples until the adhesive sets.
  - C. Seal all breaks and joints in vapor barrier with 2-½" wide pressure sensitive tape to match vapor barrier facing. Adhere with Foster 85-20 adhesive where necessary.
  - D. Wrap insulation on all exposed ducts and supply ducts within equipment rooms with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) adhered and coated with Foster No. 30-36 coating.
  - E. High pressure ductwork furnished with inner insulation for sound attenuation, as indicated on the Drawings, does not require exterior insulation.
  - F. Cover all variable air volume and mixing box necks.
- 3.8 Cover all low pressure supply air ducts not in equipment rooms as follows:
- A. All supply air ducts shall be insulated with 1- ½" thick, 1 lb. density blanket flexible duct insulation.
  - B. Adhere insulation to duct surface with Foster No. 85-20 adhesive applied in 6" wide strips on 12" centers. Butt all edges of insulation and seal all joints with a foil-skrim-draft tape or flange adhered over the joint. Secure insulation with flare door staples until the adhesive sets.
  - C. Seal all breaks and joints in vapor barrier with 2-½" wide pressure sensitive tape to match vapor barrier facing. Adhere with Foster 85-20 adhesive where necessary.
  - D. Cover all round low pressure ductwork (including that on the downstream side of the air terminal boxes).
  - E. Wrap insulation on all exposed ducts with glass cloth (minimum 6 x 6 weave/inch, 4.3 ounces per square yard) adhered and coated with Foster No. 30-36 coating.
- 3.9 Cover chilled water pump casings as follows:
- A. Insulate with 1" thick elastomeric sheet insulation.
  - B. Do not cover permanent labels or nameplates.
- 3.10 Wrap hot water reheat coils when installed in ductwork or connected to terminal boxes in air conditioning systems. Insulation shall be 1-1/2" thick, 1 lb. density blanket flexible duct insulation properly sealed with adjacent insulation or ductwork.
- 3.11 Not used.
- 3.12 Application shall be made on clean, dry surfaces with all joints butted firmly together.
- 3.13 All chilled water pipe insulation to be continuous through floors, walls, ceilings, roofs and pipe hangers.

- 3.14 Insulation shall not be applied until the general construction has progressed sufficiently to insure against physical or moisture damage to the insulation. All damaged insulation shall be replaced at this Contractor's expense.
- 3.15 Install 20 gauge galvanized steel insulation protectors on all insulated exposed pipes passing through floor. Sleeves to be 12" above the floor.
- 3.16 Hanger rods must be perpendicular before insulation is installed.
- 3.17 Longitudinal lap joints and butt strips for glass fiber pipe insulation shall be secured with staples or three (3") inch centers and sealed with an approved vapor barrier adhesive where applicable. Staples are not required when insulation utilizes a "double" adhesive self sealing system.

**END OF SECTION**

## SECTION 23 18 29.13 - HUMIDIFIER (ELECTRIC)

### PART 1 GENERAL

#### 1.01 REFERENCE

- A. Section 23 05 13 - ELECTRICAL WORK

#### 1.02 SCOPE

- A. Furnish and install a self-contained disposable cylinder, packaged, electrode, steam generating humidifier complete with steam distributor(s), and all controls. Unit shall be UL and CSA listed as a total package.

### PART 2 PRODUCTS

- 2.01 Humidifier shall be Nortec Industries, Inc. "Condair" Series EL. Unit shall have minimum capacity of 20 lbs. per hour output at 208 volts, \_\_\_\_\_ amps, 3 phase, 60 hertz, 7.5 kW. Humidifier shall discharge pure steam with no mineral dust carryover and shall be adjustable from 20% to 100% of output capacity. Unit shall have two (2) year warranty on all parts except cylinders and standard maintenance items.
- 2.02 Unit shall have 2 cylinder(s) with independent electronic control for each cylinder. Cylinder(s) shall be constructed of high temperature plastic containing lattice electrodes. Cylinder(s) shall have clamp type tubing connections and plug-in electrical connections for easy removal. Each cylinder must have a high water level cut-off to eliminate water from entering steam outlet and hose. Unit must have full cylinder indicator light. One spare cylinder for each cylinder in unit shall be furnished.
- 2.03 Cabinet shall be of 16 gauge galvanized steel with baked enamel finish. All other components in contact with water or steam shall be of corrosion resistant plastic, brass, or similar material.
- 2.04 Factory wired electrical system shall consist of terminal blocks, fused control transformer, contactors, relays, thermal overloads, solid state printed circuit control boards and internal wiring.
- 2.05 Controls provided on main unit shall include steam output meter, on-off drain switch, auto-on switch, full cylinder indicator light and 100 - 20% capacity adjustment potentiometer. Unit shall be equipped with auto-adaptive control system to monitor and control contained water at elevated conductivity of 2200 ohms minimum.
- 2.06 Factory mounted water side accessories shall include: fill solenoid valve, drain solenoid valve, water fill cup assembly, inlet strainer and 1/4" copper compression fitting.
- 2.07 Steam distributor shall be multi-part design with mounting plate, steam supply and drain connections and separate condensate return line. Furnish unit with insulated flexible steam supply hose and flexible rubber condensate return hose.
- 2.08 Control devices shall be furnished as follows:
  - A. On-off duct mounted humidistat, 15-90% R/H range with 5% non- adjustable differential.
  - B. Unit enable input by BAS system – coordinate with TCC.
  - C. Air proving, on-off, duct mounted pressure differential switch with operating range from 0.07 to 12.0 inches W.C.

- D. High limit, on-off duct mounted humidistat, 15 to 95% R/H range to stop humidifier if duct air approaches saturation.
- 2.09 Humidifiers by Carnes or Armstrong meeting specified requirements may be furnished at the Contractor's option.

**PART 3 EXECUTION**

- 3.01 Installation shall be in accordance with manufacturer's recommendations.
- 3.02 Mount unit on wall where indicated on drawings.
- 3.03 Connect SOFT water line to unit with 1/4" soft copper tubing; compression fitting.
- 3.04 Extend 3/4" copper tubing drain line from unit to drain. Provide clamp connection to 7/8" OD plastic drain on unit.
- 3.05 Extend 3/4" Type M hard copper from unit to steam distributor. Slope line from humidifier to steam distributor per manufacturer's recommendations. Provide clamp connections at unit and distributor.
- 3.06 Condensate line shall be 3/8" OD copper, trapped as recommended by manufacturer. Provide clamp connections.
- 3.07 All soldering of copper lines shall be silfos.
- 3.08 Mount steam distributors and duct humidistat per manufacturer's recommendations.
- 3.09 Electrical Contractor shall provide disconnect switch and make wiring hookup to main terminal block. Control hookup to remote sensors and controls by this Contractor.

End of Section

## **SECTION 23 21 13.13 - CHILLED WATER PIPING SYSTEM**

### **PART 1 GENERAL**

#### **1.1 REFERENCE**

- A. Section 23 05 30 - INSTALLATION OF PIPING
- B. Section 23 07 00 - HVAC INSULATION

#### **1.2 SCOPE**

- A. From existing chilled water mains located in the equipment room (and surrounding rooms), extend a system of chilled water piping to the chilled water pumps, chilled water coils in air handling units, and chilled water fan coil units.

### **PART 2 PRODUCTS**

- 2.1 Pipe - Schedule 40 black seamless or electric welded ASTM A-53, Grade A with Schedule 40, 150 lb. swp steel welding fitting, except 2" and smaller pipe option 125 lb. cast iron screwed fitting. Elbows shall be long radius type.
- 2.2 Fittings for piping 2-1/2" and smaller - 125 lb. black cast iron except the CM may, at his option, use weld joints in piping 1-1/2" and larger. Use standard weight welding fittings.
- 2.3 Fittings for piping 3" and larger - standard weight welding fittings.
- 2.4 At the Contractor's option, weldolets, butt or threaded type, may be used for branch connections that are less than 2/3 main size. Use welded or screwed fittings for branch connections 2/3 main size or larger. Shaped nipples are not acceptable.
- 2.5 The Contractor, at his option, may use copper pipe and fittings for all pipe less than 4". Pipe shall be Type L hard drawn copper tubing with wrought copper solder type fittings. All joints shall be made with a 6 percent silver alloy with a 1000°F solidus minimum.

### **PART 3 EXECUTION**

- 3.1 Install water mains without pitch. Use eccentric reducing couplings at changes in size, with top of pipes at same elevation. Use concentric reducers in vertical mains.
- 3.2 Install manual air vents at high points of the system for proper air venting of system.
- 3.3 The HVAC Contractor shall be responsible for draining down the existing chilled water piping system as need to tie into the existing chilled water system.

### **END OF SECTION**





## **SECTION 23 21 13.23 - HOT WATER HEATING PIPING SYSTEM**

### **PART 1 GENERAL**

#### **1.1 REFERENCE**

- A. Section 23 05 30 - INSTALLATION OF PIPING
- B. Section 23 07 00 - HVAC INSULATION

#### **1.2 SCOPE**

- A. From the existing heating hot water mains, provide a system of heating hot water piping to the new heating water pumps, fan coil units, unit heaters, air handling unit coils, reheat coils, and finned tube radiation.

### **PART 2 PRODUCTS**

- 2.1 Pipe - Schedule 40 black seamless or electric welded ASTM A-53, Grade A with Schedule 40, 150 lb. S.W.P. steel welding fitting, except 2" and smaller pipe option 125 lb. cast iron screwed fitting. Elbows shall be long radius type.
- 2.2 Fittings for piping 2-1/2" and smaller - 125 lb. black cast iron except the Contractor may, at his option, use weld joints in piping 1-1/2" and larger. Use standard weight welding fittings.
- 2.3 Fittings for piping 3" and larger - standard weight welding fittings. Welded joints shall be made using the gas tungsten arc welding process for the root pass of all circumferential butt welds. A consumable insert ring shall be used for fit-up as required. The consumable insert ring material shall be compatible with the pipe material.
- 2.4 At the Contractor's option, weldolets, butt or threaded type, may be used for branch connections that are less than 2/3 main size. Use welded or screwed fittings for branch connections 2/3 main size or larger. Shaped nipples are not acceptable.
- 2.5 The Contractor, at his option, may use copper pipe and fittings for all pipe less than 4". Pipe shall be Type L hard drawn copper tubing with wrought copper solder type fittings. All joints shall be made with a 6 percent silver alloy with a 1000°F solidus minimum.

### **PART 3 EXECUTION**

- 3.1 Install water mains without pitch. Use eccentric reducing couplings at changes in size, with top of pipes at same elevation. Use concentric reducers in vertical mains.
- 3.2 Branches to units below mains to be taken from bottom of mains at a 45 degree angle, pitch downward toward units. Branches to units above mains to be taken from top of mains at a 45 degree angle, pitched upward toward units. Pitch not less than 1" in 10'.
- 3.3 Install manual air vents with manual shut off valves at high points of the system for proper air venting of system.

### **END OF SECTION**



## **SECTION 23 21 13.33 - CONDENSATION DRAIN AND DRAIN PIPING SYSTEMS**

### **PART 1 GENERAL**

#### 1.1 REFERENCE

- A. Section 23 05 30 - INSTALLATION OF PIPING
- B. Section 23 07 00 - HVAC INSULATION

#### 1.2 SCOPE

- A. Provide condensation drain piping from outlets on drain pans of all cooling coils, and run indirect to floor drains and elsewhere as shown on the Drawings.
- B. Provide drain piping from drain valves and overflows to floor drains and elsewhere as indicated.

### **PART 2 PRODUCTS**

#### 2.1 PIPE

- A. Type "L" hard copper, minimum size 1 inch. Specify that wrought copper fittings with sweat joints of 95-5 solder be used. Trap drain lines and run to suitable drains.

#### 2.2 Fittings cast brass drainage fittings.

### **PART 3 EXECUTION**

3.1 Provide cleanouts at traps and in the piping system where pipe changes direction.

3.2 Pitch all condensation and other drain lines down a minimum of 1" in 8' in the direction of flow.

3.3 Prior to leaving the jobsite, the Contractor shall flood the cooling coil drain pans with the units operating to verify that the drain pans are draining properly.

### **END OF SECTION**



## SECTION 23 21 23.16 - END SUCTION PUMPS

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Divisions 01 Specifications Sections, apply to this Section.
- B. Section 230105, Paragraph 1.4 - OHIO ENERGY CODE
- C. Section 230513 - ELECTRICAL
- D. Section 230530 - INSTALLATION OF PIPING
- E. Section 232113.23 - HOT WATER HEATING PIPING SYSTEM
- F. Section 250000 - TEMPERATURE CONTROLS
- G. Section 250001 – SEQUENCE OF OPERATION FOR HVAC CONTROLS

#### 1.2 SCOPE

- A. Provide end suction, flexible coupled pumps for the chilled water and heating hot water systems as shown on the Drawings.
- B. Provide piping to the pumps as shown on the Drawings.

#### 1.3 SUBMITTALS

- A. Provide dimensional drawings and product data on each pump.
- B. Provide pump curves for each pump at the specified operation point, with the flow, pressure and horse power clearly plotted.
- C. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, alignment, receiving, handling, storage, safety information and cleaning. Provide a troubleshooting guide, parts list, warranty and electrical wiring diagrams.

#### 1.4 QUALITY ASSURANCE

- A. Each pump shall be given a vibration and pump alignment analysis by the manufacturer's representative.
- B. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation.
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual.

- C. Handling: Handle and lift pumps in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

#### 1.6 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
  - 1. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the from the date of occupancy.
  - 2. Motor Warranty is warranted by the motor manufacturer for a period of one year from the date of occupancy.

### PART 2 - PRODUCTS

- 2.1 End suction, flexible coupled pumps shall be base-mounted, single stage, end suction design, bronze fitted centrifugal type with bronze case wearing rings, ball bearings, motors, flexible couplings, coupling guards, and channel steel bases unless otherwise noted. Pumps shall be serviceable without the need to disconnect suction and discharge piping from the pump casing.
  - A. Manufacturer – Bell & Gossett Series E 1510
  - B. Pump volute shall be made of ductile iron with integrally cast pedestal support. The impeller shall be cast bronze, enclosed type, statically and hydraulically balanced. Impeller shall be keyed to the shaft and secured by a hex head impeller nut and washer.
  - C. Pumps shall be provided with a single inside unbalanced mechanical shaft seal for leakless operation. A suitable arrangement shall be provided to furnish a portion of the pumped liquid to lubricate and cool the seal faces.
  - D. Pump shall be rated for a minimum of 175 psi working pressure. Casings shall be provided with tapped and plugged holes for priming, vent, and drain.
  - E. Pump bearing housing shall have heavy duty re-greasable ball bearings.
  - F. Base plate shall be channel steel, sufficiently rigid to support the pump and driving motor. A flexible-type coupler, capable of absorbing torsional vibration, shall be employed between the pump and motor, and it shall be equipped with a suitable coupling guard as required. Contractor to level and grout each unit according to manufacturer's instructions.
  - G. Each pump shall be factory tested. It shall then be thoroughly cleaned and painted with at least one coat of high grade machinery enamel prior to shipment.
  - H. Each pump shall be checked by the contractor and regulated for proper differential pressure, voltage and amperage draw. This data shall be noted on a permanent tag or label and fastened to the pump for owner's reference.
  - I. All pumps shall be furnished with bronze shaft sleeves and mechanical shaft seals. Seals shall be rated for 250°F. water temperature.

- 2.2 Pump capacities shall be as shown on the Drawings at total head noted. The operating point of each pump at the conditions shown shall be within five (5) percentage points of the maximum efficiency on its impeller curve. The impeller furnished shall not exceed 90 percent of the maximum diameter catalogued impeller available for the pump casing furnished. To assure stable pump operation, the impeller curve shall be continuously rising throughout the range contained within its efficiency curves. The peak of the impeller curve at maximum total head shall be a minimum of 10 percent above the total head shown on the Drawings. The pump shall not overload the motor at any point on the impeller curve.
- 2.3 Motors shall be 1750 RPM, 60 Hertz, three phase, maximum 40°C ambient, open drip-proof with grease packed bearings and grease seals and fittings. Voltage as scheduled on the Drawings. Size of motor as indicated on the Drawings. Motor shall be equal to Baldor Premium efficiency type and shall meet Ohio Energy Code and have 1.15 service factor. Efficiency at 1/4, 1/2, 3/4 or full load shall not be less than 91%. Motor for the secondary chilled water pumps and heating water pumps shall be high efficiency type for use with variable frequency inverter.
- A. Pump and motor shall be factory aligned, and shall be realigned by contractor after installation.
  - B. Motors shall be “Inverter Ready” per NEMA Std. MG1 part 31.4.4.2 and labeled as such. Shaft grounding rings shall be provided.
  - C. Provide two-year parts only warranty for the motor.
  - D. Refer to section 23 05 13 for additional motor requirements.
- 2.4 Motor horsepower shall not be smaller than that scheduled. Pump furnished must operate within 5% of efficiency noted on Drawings and meet all other requirements specified.
- 2.5 Pumps by Aurora, Grundfos, *TACO* or Armstrong of the same type, size, and capacity and meeting all specification requirements may be furnished at the Contractor’s option. Pumps furnished must operate within 5% of efficiency noted on drawings and meet all other requirements specified.

### **PART 3 - EXECUTION**

- 3.1 Install suction diffusers at suction of pumps.
- 3.2 Pump Alignment - The Contractor, before starting any pumping unit with pump and driver mounted on a common base plate with a flexible coupling, shall check the following points:
- A. Make sure base plate is level in both directions.
  - B. Make sure pump shaft and driver shaft are parallel in both horizontal and vertical planes.
  - C. Make sure shafts are concentric.
  - D. Align coupling flanges for concentricity to assure that the face and curved edges are concentric within the manufacturer’s recommendations.
  - E. Align coupling for angular alignment to tolerances recommended by the manufacturer.
  - F. Align coupling for parallel alignment.
  - G. The final coupling alignment shall be documented and the results furnished in writing to the A/E. Field check all alignments and report the maximum angular and eccentric misalignments to the nearest 0.001 inch.



- 3.3 Starters, disconnects and wiring by Electrical Contractor.
- 3.4 Install pumps on 4" high concrete pads and inertia bases by the HVAC Contractor.
- 3.5 Install flexible connectors on suction and discharge sides of pumps.
- 3.6 Install a vent cock on the volute casing.
- 3.7 Mount pumps as shown on the drawings.
- 3.8 Support vertical piping drops from floor or isolation base (when furnished) to avoid stress on pump connections.
- 3.9 Pipe the pump base drip lips to the nearest floor drain.
- 3.10 Tighten bolts on all pump flexible connections to the manufacturer's specified torque.

**END OF SECTION**

## SECTION 23 31 13.13 - LOW PRESSURE DUCTWORK

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Section 23 01 10 - MANUFACTURER'S AND COORDINATION DRAWINGS
- B. Section 23 07 00 - HVAC INSULATION
- C. Section 23 33 13 - DAMPERS AND LOUVERS
- D. Section 23 37 13 - REGISTERS, GRILLES AND DIFFUSERS

#### 1.2 SCOPE

- A. Furnish, install and insulate low pressure sheet metal work and appurtenances with sizes as shown on Drawings.
- B. All sheet metal work including ductwork, dampers, etc., shall be fabricated in accordance with the recommendations of the Sheet Metal and Air Conditioning Contractors National Association, Inc., (SMACNA) latest edition of the FOLLOWING:
  - 1. HVAC DUCT CONSTRUCTION STANDARDS, Metal and Flexible.
- C. The use of duct liner is prohibited.
- D. This contractor is to provide 3 dimensional (3D) coordination model sheet metal drawings for use in coordinating work of Plumbing, Fire Protection and Electrical with layout of air distributions system and related work. Per 23 01 10, paragraph 1.1 E.

### PART 2 PRODUCTS

#### 2.1 Sheet Metal Ductwork:

- A. Unless otherwise noted, all sheet metal ducts and plenums shall be fabricated of lock forming quality, hot-dipped galvanized steel sheets and shall comply with 2" w.g. pressure class construction. Metal gauges shall be in accordance with current SMACNA Standards.
- B. Flexible duct shall comply with NFPA requirements, Pamphlet 90A, and shall be UL listed with flame spread rating of 25 or less and smoke developed rating of 50 or less. Duct shall be a factory fabricated assembly composed of: an inner duct of woven and coated fiber glass providing an air seal and bonded permanently to corrosion resistant coated steel wire helix and 1" thick fiber glass insulating blanket and low permeability outer vapor barrier of fiber glass reinforced metallized film laminate.

Flexible duct shall be terminal duct for air system and shall not exceed 5 feet in length. Do not make more than one (1) 90 degree bend with flexible duct. Bend radius shall be minimum of two (2) times duct diameter.

- 1. Flexible duct shall be Thermaflex MKC.
- 2. Duct shall be rated for minimum 10" W.G. internal working pressure, for all duct sizes.
- 3. Vinyl, clear plastic or mylar type liners are expressly prohibited.

4. Flexmaster Type 3M insulated or Wiremold WCK flexible duct meeting all specified requirements may be furnished at the Contractor's option.
- C. All fan flexible connections shall be made with commercial grade neoprene coated glass fabric (heavy duty).
- D. All duct sealing compounds and mastics shall meet NFPA 90A standards and shall be UL listed with ratings not to exceed 25 for flame spread and 50 for smoke development.
- E. Access doors shall be insulated, airtight, "hinged" and gasketed style, with a minimum of two quick action latches. Door shall be mounted in a galvanized steel frame with an inside "fold-over" flange for duct attachment. Door height shall be 24"; width shall be equal to the duct width or 12", whichever is less, unless otherwise shown or noted on drawings.
- F. Sealer for ducts shall be equal to 3M Model EC-800.

### 3.2 FLEXIBLE AND ROUND DUCT CONNECTIONS

- A. Connection of flexible and round ducts to rectangular ducts to be made with spin-in type fittings complete with damper with locking operator.

### 3.3 FITTINGS AND ACCESSORIES

- A. Install flexible connections in all duct connections to fans and air handling units, unless otherwise noted.
- B. Install manual balancing dampers with locking quadrants where shown on the Drawings and as required for proper balancing of the systems. Locking quadrants shall be easily accessible. On insulated ducts, locking quadrants shall be installed on outside of insulation.
- C. Install double turning vanes in all right angle elbows. Install 45° tap collar for branch ducts and register openings.
- D. Provide access doors in ducts to all automatic dampers, fire dampers and elsewhere as shown on drawings unless otherwise noted. Doors shall be minimum 12" x 24", or duct width x 24", whichever is smaller, unless otherwise noted. Access doors at fire dampers shall be located so that fire dampers may be reopened from them in case of fusible link failure.
- E. Provide minimum 12" x 12" access doors in each supply air duct where smoke detector element passes through duct.
- F. All duct joints in supply, return and exhaust duct systems shall be sealed with duct sealer per SMACNA Seal Class A.
- G. All "Auto-Control" dampers shall be furnished by the Temperature Control Sub-Contractor, but installed by the Contractor. All other dampers, including "motorized dampers", shall be provided by the HVAC Contractor.
- H. All round ductwork and fittings shall be spiral lockseam construction equivalent to United Sheet Metal.
- I. The use of multi-piece adjustable angles and elbows is prohibited.

**END OF SECTION**

## SECTION 233113.16 - HIGH PRESSURE DUCTWORK

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Divisions 01 Specifications Sections, apply to this Section.
- B. Section 23 05 93 - TESTS AND ADJUSTMENTS
- C. Section 23 07 00 - HVAC INSULATION
- D. Section 23 33 13 - DAMPERS

#### 1.2 SCOPE

- A. Furnish and install high pressure, high velocity sheet metal work and appurtenances with sizes as shown on Drawings.
- B. All sheet metal work on the discharge side of AHU-5 and AHU-6 connected to Medium Velocity VAV Boxes or Control Dampers shall be high pressure construction.
- C. All sheet metal work including ductwork, dampers, etc., shall be fabricated in accordance with the recommendations of the Sheet Metal and Air conditioning Contractors National Association, Inc., (SMACNA) latest edition of the "HVAC Duct Construction Standards, Metal and Flexible".

### PART 2 PRODUCTS

- 2.1 All high pressure ducts shall be galvanized steel (unless otherwise noted) and shall comply with 6" w.g. pressure class construction in accordance with current SMACNA Standards.
- 2.2 All round ducts 60" diameter and smaller shall be spiral lockseam construction of gauges as recommended by SMACNA.
- 2.3 All flat oval ducts shall be spiral lockseam construction of gauges as recommended by SMACNA.
- 2.4 All flat oval duct sections shall not be more than 12 foot long and reinforced with angle braces at each joint and as a minimum at the mid-point between joints of each section. Spacing between braces shall not exceed duct manufacturer's recommendation.
- 2.6 All fittings shall be manufactured from 20 gauge (thru 36" diameter), 18 gauge (37" thru 50" diameter) and 16 gauge (51" and over) zinc- coated steel with continuous corrosion resistant welds.

- 2.7 All 90 degree elbows in size 3" through 8" diameter shall be die- stamped for minimum air friction loss with continuous corrosion- resistant welds.
- 2.8 Elbows - 9" diameter and over - 5-piece fabrication.
- 2.9 Square elbows - Mitered 90 degrees with minimum 4 or 5 turning vanes.
- 2.10 Tees and laterals - low loss conical type fittings straight or reducing as required.
- 2.11 Couplings, end caps, slip joints, concentric reducer and transitions to be standard fittings.
- 2.12 All access doors shall be 20 gauge, (U. S. Standard) reinforced, insulated, gasket doors with sufficient quick opening fasteners to insure a tight seal, and provided with chain retainer and cover handle. Doors to open inward to serve as vacuum release devices. Minimum size of access doors shall be as follows:

ROUND DUCT

FLAT OVAL DUCT

Size	Duct Diameter	Major Axis When	Minor Axis When
		Mounted On	Mounted On
		Major Axis	Minor Axis
8" x 12"	8" to 12"	8" to 16"	8" to 11"
12" x 12"	13" to 18"	17" to 24"	12" to 13"
14" x 20"	19" & over	25" & over	14" & over

- 2.13 All round and flat oval high velocity ductwork and fittings shall be as manufactured by United Sheet Metal, SET Duct Manufacturing, Semco, Tangent Air or Eastern.

2.14 Flexible Duct

- A. Flexible duct shall comply with NFPA requirements, Pamphlet 90A, and shall be UL listed with flame spread rating of 25 or less and smoke developed rating of 50 or less. Duct shall be factory fabricated assembly composed of: an inner duct of woven and coated fiber glass cloth providing an air seal and bonded permanently to corrosion resistant coated steel wire helix and 1" thick fiber glass insulating blanket and low permeability outer vapor barrier of fiber glass reinforced metalized film laminate.

Flexible duct shall be terminal duct for air system and shall not exceed 5 feet in length. Do not make more than one (1) 90 degree bend with flexible duct. Bend radius shall be minimum of two (2) times duct diameter.

- 1. Flexible duct shall be Thermaflex MKC.
- 2. Duct shall be rated for minimum 10" W.G. internal working pressure, for all duct sizes.
- 3. Vinyl, foil, clear plastic or mylar type liners are expressly prohibited.

4. Flexmaster Type 4M insulated or Wiremold WCK flexible duct meeting all specified requirements may be furnished at the Contractor's option.
- 2.15 All duct sealing compounds and mastics shall meet NFPA 90A Standards and shall be UL listed with ratings not to exceed 25 for flame spread and 50 for smoke development.

### PART 3 EXECUTION

- 3.1 All circumferential joints shall be slip joints properly sealed with sealing compound inside the joint and mechanically fastened with drive screws. Use minimum number of drive screws to allow sealing compound to set properly. Coat outside of joint with sealing compound.
- 3.3 Construct square rectangular ducts and transitions with duct sealer in seams. Use mastic or suitable soft gaskets in joints. Bolt flanges with ¼" bolts maximum 6" on centers.
- 3.4 See "Tests and Adjustments" Section for testing of high pressure sheet metal work.
- 3.5 Provide access doors adjacent to all dampers, including fire dampers, and control devices. Access doors at fire dampers shall be located so that fire dampers may be reopened from them in case of fusible link failure. All access doors shall be installed with sufficient quick opening fasteners to insure a tight seal.
- 3.6 Install flexible connections in all duct connections to all fans. All flexible connections shall be made with commercial grade neoprene coated glass fabric (heavy duty).

- 3.7 Exposed duct sealer is not acceptable on exposed ductwork. Ductwork shall be sealed on the inside or gasket ductwork shall be used.

END OF SECTION 23 31 13.16

## SECTION 233113.16 - HIGH PRESSURE DUCTWORK

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Divisions 01 Specifications Sections, apply to this Section.
- B. Section 23 05 93 - TESTS AND ADJUSTMENTS
- C. Section 23 07 00 - HVAC INSULATION
- D. Section 23 33 13 - DAMPERS

#### 1.2 SCOPE

- A. Furnish and install high pressure, high velocity sheet metal work and appurtenances with sizes as shown on Drawings.
- B. All sheet metal work on the discharge side of AHU-5 and AHU-6 connected to Medium Velocity VAV Boxes or Control Dampers shall be high pressure construction.
- C. All sheet metal work including ductwork, dampers, etc., shall be fabricated in accordance with the recommendations of the Sheet Metal and Air conditioning Contractors National Association, Inc., (SMACNA) latest edition of the "HVAC Duct Construction Standards, Metal and Flexible".

### PART 2 PRODUCTS

- 2.1 All high pressure ducts shall be galvanized steel (unless otherwise noted) and shall comply with 6" w.g. pressure class construction in accordance with current SMACNA Standards.
- 2.2 All round ducts 60" diameter and smaller shall be spiral lockseam construction of gauges as recommended by SMACNA.
- 2.3 All flat oval ducts shall be spiral lockseam construction of gauges as recommended by SMACNA.
- 2.4 All flat oval duct sections shall not be more than 12 foot long and reinforced with angle braces at each joint and as a minimum at the mid-point between joints of each section. Spacing between braces shall not exceed duct manufacturer's recommendation.
- 2.6 All fittings shall be manufactured from 20 gauge (thru 36" diameter), 18 gauge (37" thru 50" diameter) and 16 gauge (51" and over) zinc- coated steel with continuous corrosion resistant welds.



- 2.7 All 90 degree elbows in size 3" through 8" diameter shall be die- stamped for minimum air friction loss with continuous corrosion- resistant welds.
- 2.8 Elbows - 9" diameter and over - 5-piece fabrication.
- 2.9 Square elbows - Mitered 90 degrees with minimum 4 or 5 turning vanes.
- 2.10 Tees and laterals - low loss conical type fittings straight or reducing as required.
- 2.11 Couplings, end caps, slip joints, concentric reducer and transitions to be standard fittings.
- 2.12 All access doors shall be 20 gauge, (U. S. Standard) reinforced, insulated, gasket doors with sufficient quick opening fasteners to insure a tight seal, and provided with chain retainer and cover handle. Doors to open inward to serve as vacuum release devices. Minimum size of access doors shall be as follows:

ROUND DUCT

FLAT OVAL DUCT

Size	Duct Diameter	Major Axis When	Minor Axis When
		Mounted On	Mounted On
		Major Axis	Minor Axis
8" x 12"	8" to 12"	8" to 16"	8" to 11"
12" x 12"	13" to 18"	17" to 24"	12" to 13"
14" x 20"	19" & over	25" & over	14" & over

- 2.13 All round and flat oval high velocity ductwork and fittings shall be as manufactured by United Sheet Metal, SET Duct Manufacturing, Semco, Tangent Air or Eastern.

2.14 Flexible Duct

- A. Flexible duct shall comply with NFPA requirements, Pamphlet 90A, and shall be UL listed with flame spread rating of 25 or less and smoke developed rating of 50 or less. Duct shall be factory fabricated assembly composed of: an inner duct of woven and coated fiber glass cloth providing an air seal and bonded permanently to corrosion resistant coated steel wire helix and 1" thick fiber glass insulating blanket and low permeability outer vapor barrier of fiber glass reinforced metalized film laminate.

Flexible duct shall be terminal duct for air system and shall not exceed 5 feet in length. Do not make more than one (1) 90 degree bend with flexible duct. Bend radius shall be minimum of two (2) times duct diameter.

- 1. Flexible duct shall be Thermaflex MKC.
- 2. Duct shall be rated for minimum 10" W.G. internal working pressure, for all duct sizes.
- 3. Vinyl, foil, clear plastic or mylar type liners are expressly prohibited.

4. Flexmaster Type 4M insulated or Wiremold WCK flexible duct meeting all specified requirements may be furnished at the Contractor's option.
- 2.15 All duct sealing compounds and mastics shall meet NFPA 90A Standards and shall be UL listed with ratings not to exceed 25 for flame spread and 50 for smoke development.

### PART 3 EXECUTION

- 3.1 All circumferential joints shall be slip joints properly sealed with sealing compound inside the joint and mechanically fastened with drive screws. Use minimum number of drive screws to allow sealing compound to set properly. Coat outside of joint with sealing compound.
- 3.3 Construct square rectangular ducts and transitions with duct sealer in seams. Use mastic or suitable soft gaskets in joints. Bolt flanges with ¼" bolts maximum 6" on centers.
- 3.4 See "Tests and Adjustments" Section for testing of high pressure sheet metal work.
- 3.5 Provide access doors adjacent to all dampers, including fire dampers, and control devices. Access doors at fire dampers shall be located so that fire dampers may be reopened from them in case of fusible link failure. All access doors shall be installed with sufficient quick opening fasteners to insure a tight seal.
- 3.6 Install flexible connections in all duct connections to all fans. All flexible connections shall be made with commercial grade neoprene coated glass fabric (heavy duty).

- 3.7 Exposed duct sealer is not acceptable on exposed ductwork. Ductwork shall be sealed on the inside or gasket ductwork shall be used.

END OF SECTION 23 31 13.16

## SECTION 23 33 13 – DAMPERS AND LOUVERS

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Section 23 31 13.13 - LOW PRESSURE DUCTWORK

#### 1.2 SCOPE

- A. Furnish and install dampers and appurtenances with size and capacities as shown on Drawings.
- B. Furnish and install louvers and appurtenances with size and capacities as shown on Drawings.

### PART 2 PRODUCTS

#### 2.1 MANUAL BALANCING DAMPERS

- A. Based on Ruskin Type MD-35/0B opposed blade with molded synthetic bearings, 6" wide 16 gauge galvanized steel blades, extended shaft and linkage.
  - 1. Balance dampers for round ducts shall be Ruskin MDRS- 25 single blade, 20 gauge galvanized steel.
  - 2. All dampers shall be equipped with locking quadrants.
- B. At the Contractor's option, manual balancing dampers shall be manufactured by the Contractor per SMACNA Standards. Dampers shall have locking quadrants on both sides of the duct.

#### 2.2 MOTOR OPERATED DAMPERS

- A. Motor operated dampers shall be Ruskin Type CD-50, opposed blade with self-lubricating molded synthetic bearings, 5" X 1" X .125-6063 T5 extruded aluminum hat channel with hat mounting flanges on both sides of frame. 6" wide 6063 T5 heavy gauge extruded aluminum airfoil shape blades. Anti-leakage jamb seals, vinyl gasket blade seals, extended shaft and linkage. Maximum allowable leakage through dampers, 6 CFM per sq. ft. at 4" of static pressure behind louver. All dampers shall be equipped with multiple 120 volt, 60 cycle, single phase motor operators as required. Spring closed.

#### 2.3 FIRE DAMPERS

- A. Fire dampers in low velocity ductwork shall be Ruskin model DIBD2 Dynamic Type "B" with interlocking hinged blades out of the airstream unless otherwise noted. All dampers shall be UL approved and labeled and shall meet all requirements of NFPA No. 90A. Furnish with UL labeled fusible links with temperature ranges to conform to NFPA recommendations. All fire dampers shall be dynamic type.
  - 1. Furnish and install, at locations shown on the plans, dynamic fire dampers tested, constructed and labeled in accordance with the latest edition of UL Standard 555. Dampers shall have a fire rating of 1 1/2 hours and shall meet the requirements of the latest edition of NFPA90A.

2. Each damper shall include a 165°F fusible link and shall be labeled for use in dynamic systems. Dampers labeled for use in static systems only are not permitted. The damper shall be rated for dynamic closure at 2000 fpm and 4 inches w.g. static pressure and shall be rated to close with airflow in either direction.
  3. Each dynamic fire damper shall include a steel sleeve and mounting angles furnished by the damper manufacturer to ensure appropriate installation. Submittal information shall include the fire protection rating, maximum velocity/pressure ratings and the manufacturer's UL installation instructions. The dampers shall be installed in accordance with the manufacturer's UL installation instructions.
- B. Fire dampers in high velocity ductwork shall be Ruskin multiple blade type FD60. All dampers shall be UL approved and labeled and shall meet all requirements of NFPA No. 90A. Furnish with UL labeled fusible links with temperature ranges to conform to NFPA recommendations. All dampers shall be dynamic type.
1. Furnish and install at locations shown on plans or as described in schedules multiple blade fire dampers constructed and tested in accordance with UL Safety Standard 555 that meet or exceed the following specifications. Damper frame (when size permits) shall be constructed using the UniFrame Design Concept (UDC) and shall be a minimum of 16 gage galvanized (1.52) steel formed into a structural hat shaped steel channel structurally superior to 13 gage (2.3) channel frame. The blades shall be single piece, airfoil shaped with 14 gage (1.90) equivalent thickness. Bearings shall be stainless steel sleeve turning in an extruded hole in the frame.
  2. Each fire damper shall have a 1 1/2 hour fire protection rating, 165°F fusible link, and shall have been tested to close under dynamic airflow conditions in a multiple section size with pressures up to 8" and velocities up to 4000 fpm. In addition, the dampers shall be AMCA licensed for air performance and shall bear the AMCA Certified Ratings Seal.
  3. Fire dampers shall be approved for vertical or horizontal installation as required by the location shown and shall be installed using steel sleeves, angles, and other materials and practices required to provide an installation in accordance with the damper manufacturer's UL approved instructions.
- C. Factory Sleeve shall be furnished with the damper the sleeve shall be minimum 20 gage thickness, minimum 17 inches long. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.

#### 2.4 STATIONARY LOUVERS

- A. Heavy duty, drainable blade type stationary louvers shall be Airolite K6776, 6" deep of 12 gauge (.081") extruded aluminum with 1/2" aluminum mesh birdscreen inside. Maximum blade spacing shall be 3-1/2". Louvers shall be certified to be weathertight when handling CFM's indicated on drawings. For comparison purposes, a 4'-0" x 4'-0" louver must have a minimum free area of 8.66 sq. ft. and a maximum pressure drop of 0.15" at 1100 FPM through free area (intake). Water penetration shall be no more than 0.003 ounces of water per square foot of free area when tested for 15 minutes at 1100 FPM per AMCA Standard 500. Louvers shall have AMCA certified rating seal. Provide data with submittals. Louvers to have continuous blade appearance.
- B. Color selected by A/E.

- 2.5 Louvers and Dampers by Ruskin, Greenheck, Air Balance, Arrow, American Warming and Ventilating, or Vent Products of the same type and meeting specified requirements, may be furnished at the Contractor's option.

### **PART 3 EXECUTION**

- 3.1 Install dampers as recommended by manufacturer.
- 3.2 Inspect areas to receive dampers. Notify the Associate of conditions that would adversely affect the installation or subsequent utilization of the dampers. Do not proceed with installation until unsatisfactory conditions are corrected.
- 3.3 Install dampers at locations indicated on the drawings and in accordance with manufacturer's UL approved installation instructions.
- 3.4 Install dampers square and free from racking with blades running horizontally.
- 3.5 Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure where required.
- 3.6 Do not compress or stretch damper frame into duct or opening.
- 3.7 Handle damper using sleeve or frame. Do not lift damper using blades, actuator, or jackshaft.
- 3.8 Install bracing for multiple section assemblies to support assembly weight and to hold against system pressure. Install bracing as needed.
- 3.9 All dampers and damper operators shall be checked and adjusted for proper operation and travel.
- 3.10 All dampers shall be labeled per Ohio Building Code and Ohio University requirements.
- 3.11 Install dampers as recommended by manufacturer.
- 3.12 Where damper actuators are located inside of shafts, coordinate the position of the damper actuators with the shaft access panel locations indicated on the architectural drawings.
- 3.13 Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish access doors in ductwork or plenums where required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
- 3.14 Stationary louvers to be installed by this Contractor. Caulk all around louvers with gun grade "Sonolastic" sealant. Caulking shall be applied with a hand gun and work shall be left neat and clean. Furnish size and locations to the General Contractor.
1. Finish to be baked enamel, color approved by A/E.
  2. Caulk color to match louver finish as closely as possible.

### **END OF SECTION**



SECTION 23 33 19 - SOUND TRAPS

PART 1 GENERAL

1.01 REFERENCE

- B. Section 23 31 13.16 - HIGH PRESSURE DUCTWORK

1.02 SCOPE

- A. Furnish and install sound traps and appurtenances.

PART 2 PRODUCTS

2.01 MODEL

- A. Rectangular silencers shall have outside castings of minimum 22 gauge galvanized steel. Splitters to be provided with inert verminproof highly absorbent acoustic material of not less than 4 pounds density. Construction shall be all welded or sealed lock seams guaranteed not to exceed 1 percent leakage at 1-1/2 times the system working pressure.

- 1. Sound Trap Manufacturer - Industrial Acoustics Company

- B. Filler material shall be inorganic glass fiber of a proper density to obtain the specified acoustic performance and be packed under not less than 5% compression to eliminate voids due to vibration and settling. Material shall be inert, vermin and moisture proof. Filler material shall be totally encapsulated and sealed with a polymer film of an approximate thickness of 1.5 mils. The encapsulated fill material shall be separated from the perforated baffles by means of a non-combustible, erosion resistant, acoustic stand-off.

2.02 The combustion rating for the unit shall meet requirements of NFPA Standard 255 with a flame spread not to exceed 20 and a smoke development rating not in excess of 20.

2.03 Sound attenuation ratings shall be determined in a duct- to-reverberant room test facility, which provides for airflow through the silencer during the rating test. Ratings shall include dynamic insertion loss and self-noise power levels.

2.04 Sound traps in supply air ducts shall be Model LFM. Units shall have a maximum pressure drop of 0.15" W.G. and sound reduction values (dynamic insertion loss, dB) of 10 in the 100-300 octave band and 15 in the 300-600 C.P.S. octave band. Based on 1500 FPM face velocity.

2.05 Sound attenuators by Semco or Vibrom of the same size, type and meeting all specified requirements, may be furnished at the Contractor's option.

PART 3 EXECUTION

3.01 Mount sound traps in ductwork as recommended by the manufacturer.



3.02 Provide additional steel as required to support sound traps.

END OF SECTION 23 33 19

## SECTION 23 34 16 - SQUARE CENTRIFUGAL INLINE FANS

### PART 1 GENERAL

#### 1.1 Reference

- A. Section 23 01 05, Paragraph 1.05 - OHIO ENERGY CODE
- B. Section 23 05 13 - ELECTRICAL WORK

#### 1.2 Scope

- A. Furnish and install duct mounted inline fans and appurtenances.

### PART 2 PRODUCTS

- 2.1 Inline fans based on Greenheck Model BSQ (belt-drive) or SQ (direct-drive) centrifugal exhausters, with balanced backward inclined type wheel, motor, pillow block ball bearings, lined galvanized steel casing and vibration isolators. Fans shall have factory mounted disconnect.
- 2.2 The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.
- 2.3 Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.
- 2.4 The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.
- 2.5 Fan ratings shall be AMCA certified and fan shall bear AMCA seals.
- 206 Motors for belt drive units shall be 1750 RPM, 460 volt / 3 phase, 60 cycle, open drip-proof with sealed pre-lubricated ball bearings. Motors shall be VFD rated. Motor shall be mounted on an adjustable base. Drive shall be V-belt type, designed for 125% of motor horsepower, with solid fan sheaves and adjustable motor sheaves. Furnish additional sheaves and belts as required to adjust fans to deliver specified air quantities at actual system static pressures. Furnish OSHA belt guard with opening at end of fan shaft.
  - A. Fans shall be furnished with factory mounted shaft grounding protection.
  - B. Variable frequency drives shall be furnished by the HVAC contractor.
- 2.7 Motors for direct drive fans shall be electronic commutation (EC) motors specifically designed for fan applications. AC induction type motors are not acceptable. Examples of unacceptable motors are: Shaded Pole, Permanent Split Capacitor (PSC), Split Phase, Capacitor Start and 3 phase induction type motors. Motors shall be permanently lubricated with heavy-duty ball bearings to match the fan load and prewired to the specific voltage and phase. Internal motor

circuitry shall convert AC power supplied to the fan to DC power to operate the motor. Motor shall be speed controllable down to 20% of full speed (80% turndown). Motor shall be a minimum of 85% efficient at all speeds.

- A. All fans that are specified to be controlled by the BAS based on building pressure shall be furnished with a Vari-Green Drive; a factory mounted and wired variable frequency drive compatible with induction motors. Drive shall be factory programmed to match the characteristics of the fan and motor on which it is installed. Operation shall be controlled by an on-board dial, 0-10V input signal, 4-20mA input signal, Modbus/BACnet communications or other Vari-Green Controls. System shall include appropriate terminal connections for a 24VDC motorized backdraft damper and control power, 4 digital inputs, 2 digital outputs, and Bluetooth connectivity with a companion app for mobile devices. Parameters of acquainted motor shall be factory set and include but not limit to voltage, speed, FLA, acceleration/deceleration time, and minimum & maximum motor frequency. Drive shall be equipped to mitigate harmonics to levels in compliance with IEEE 519 without the use of external reactors or filter. Internal circuitry shall be UL recognized and accept 3 phase input at voltage ranges of 208-240V or 380-480V. Physical enclosure of the drive shall maintain a minimum of a NEMA 4X rating. Drive status communicated through LED indication for power, run, and fault and also via the Vari-Green Drive companion app or BACnet/Modbus.
  - B. All other fans shall be furnished with a potentiometer dial mounted on the motor controller for speed control adjustment by the air balance contractor.
- 2.8 Inline fans shall be furnished with motorized backdraft dampers. Motorized dampers for fans with 120 volt motors shall have 120 volt AC single phase operators. Motorized dampers for fans with 208 volt motors shall have 24 volt DC operators. All 24 volt damper actuators shall be powered and controlled from the factory mounted Vari-Green Drive.
- 2.9 Furnish a factory mounted disconnect switch for each inline fan.
- 2.10 Inline fans by Cook, Penn-Berry, or Twin City, of the same type, size and meeting capacity requirements, may be furnished at the Contractor's option.

### PART 3 EXECUTION

- 3.1 Provide flexible connections at inlet and discharge ducts.
- 3.2 Mount unit from spring vibration isolators furnished with the unit minimum 90% efficient.
- 3.3 Auxiliary steel for supporting units to be furnished and installed by the HVAC Contractor.
- 3.4 Starters and wiring by Electrical Contractor.

END OF SECTION

## SECTION 233616 - MEDIUM VELOCITY VAV BOXES

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Divisions 01 Specifications Sections, apply to this Section.
- B. Section 23 01 05, Paragraph 1.05 - OHIO ENERGY CODE.
- C. Section 23 31 13.13 - LOW PRESSURE DUCTWORK.
- D. Section 23 31 13.16 - HIGH PRESSURE DUCTWORK.
- E. Section 25 00 00 - TEMPERATURE CONTROLS
- F. Section 25 00 01- SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

#### 1.2 SCOPE

- A. Furnish and install a DDC variable volume, "pressure independent" medium velocity air terminal units with electronic operators for air volume control, access door, attenuator section and inlet valves. Size, capacity and noise level as shown on the drawings.
- B. Boxes shall be provided with a direct digital controller and electronic actuator furnished by the Temperature Control Contractor and factory mounted by the box manufacturer.

#### 1.3 SUBMITTALS

- A. Provide dimensional drawings and product data on each VAV box.
- B. Provide air flows and pressure drops for each VAV box at the specified operation point.
- C. Provide sound power readings for the eight octave bands, decibels, and sones.
- D. Provide manufacturer's certification that VAV boxes are licensed to bear ARI seal for sound and air performance.
- E. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, receiving, handling, storage, safety information and cleaning. Provide a troubleshooting guide, parts list, warranty and electrical wiring diagrams.

#### 1.4 QUALITY ASSURANCE

- A. Performance ratings: Conform to ARI standard 880.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation.
- B. Storage: Store materials in a dry area indoor, protected from damage, and in accordance with manufacturer's instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual. Inlet and outlet duct connections along with piping connections shall be provided with temporary caps or covers to prevent entry of dirt and moisture.
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

## 1.6 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents.
  - 1. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the date of occupancy.

## PART 2 PRODUCTS

- 2.1 Variable volume medium velocity control box shall be JCI Type TSS.
- 2.2 Unit shall have factory catalogued performance ratings which conform to CFM, static pressure, discharge and radiated sound power and attenuation designated.
  - A. Cabinet shall be constructed of not lighter than 22 gauge, zinc-coated steel. (Without factory-applied enamel paint finish.) All terminal units must have an approved non-porous sealed lining system. Liner and insulation must meet requirements of UL 181 and NFPA 90A. All seams and cut edges must be sealed to prevent erosion while all discharge edges of the liner must be secured with metal brackets. Insulation shall be 4.0 lb/ft<sup>3</sup> density. Lining shall be Fiber-Free Lining System by Titus or equivalent. Liners made by Mylar, Tedlar, Silane or woven fiberglass cloth are not acceptable.
  - B. Refer to schedule on Drawings for minimum airflows.
  - C. Performance of units shall be based on tests conducted in accordance with ADC Standard 1061Rs and ASHRAE Standard 36B.
  - D. Electronic operator shall be furnished by Building Automation System Contractor and factory mounted on boxes by the box manufacturer. Mounting of the operator shall be at the expense of the box manufacturer, not the Temperature Control Contractor. See Temperature Control Section.

- E. Leakage of valves in fully closed position shall not exceed 2% of rated capacity at 4" w.g.
  - F. Automatic damper operators shall be factory installed and thoroughly tested for proper performance.
  - G. Minimum inlet SP requirement shall not exceed 0.50".
- 2.3 The Temperature Control Contractor shall field mount and wire the DDC controllers for the VAV box. The box manufacturer shall mount and wire the box motor.
- 2.4 Units shall be UL listed with a flame spread rating not to exceed 25 and a smoke development rating not in excess of 50.
- 2.5 Box shall be factory adjusted to deliver the specified air quantities within 5%. Each box shall be labeled with the capacity as adjusted and furnished with a calibration chart. Pressure taps shall be provided to measure pressure drop across unit to confirm CFM.
- 2.6 Box shall be end outlet.
- 2.7 Box shall deliver the air quantities shown on the Drawings at sound levels not to exceed the manufacturer's published sound levels for the units indicated on the Drawings.
- 2.8 Box shall be furnished with a minimum 2-row reheat coil with aluminum fins and copper tubes. Provide access door in VAV box upstream of coil.
- 2.9 All boxes shall be furnished with an attenuator section.
- 2.10 All boxes shall be furnished with a discharge air sensor. Each sensor shall be provided and installed by the Temperature Control Contractor.
- 2.11 Variable Air volume boxes by Titus, Krueger, or Price, meeting all specified requirements, may be furnished at the Contractor's option.

### PART 3 EXECUTION

- 3.1 Provide flexible connection at inlet to the box. Box shall be installed with at least two duct diameters of rigid straight duct attached directly to box inlets.
- 3.2 Support the units from the building structure with solid steel hanger rods or sheet metal strap hangers from corner points of unit, minimum 4, such that unit is self-supporting. Units shall not be supported from the duct system or piping system or ceiling suspension system.
- 3.3 The air control terminal box locations must be coordinated with all elements that shall be in or above the ceiling. This includes but is not limited to HVAC piping, plumbing piping, conduit, wiring, junction boxes, pull boxes, lighting fixtures, sprinkler heads, cable tray, speakers, smoke detectors air devices, etc. In no case shall the Contractor mount an air control terminal above a lighting fixture, speaker, diffuser or any other device mounted on the ceiling without written

permission from the Denison University. Provide ceiling access panels where the ceiling system does not afford ready access.

- 3.4 Provide a manual-automatic air vent at the coil.
- 3.5 Operating sequence of boxes shall be as described under Section 25 00 00 – TEMPERATURE CONTROLS.
- 3.6 Low voltage power and communications wiring shall be by the Temperature Control Subcontractor.

END OF SECTION 23 36 16

**SECTION 23 37 00 - REGISTERS, GRILLES AND DIFFUSERS**

**PART 1 GENERAL**

1.1 REFERENCE

- A. Section 23 31 13.13 - LOW PRESSURE DUCTWORK

1.2 SCOPE

- A. Furnish and install registers, grilles, diffusers and appurtenances.

**PART 2 PRODUCTS**

2.1 SQUARE CEILING SUPPLY AIR DIFFUSERS

- A. Adjustable air pattern steel square ceiling diffusers with round neck. Air pattern to be adjustable from full horizontal to full vertical.
  - 1. Titus TMSA with Border Type 3 frame to fit into lay-in ceiling grid.

2.2 SUPPLY AIR REGISTERS

- A. Double deflection supply air register with horizontal front bars, vertical rear bars and opposed blade dampers, key operated.
  - 1. Titus 300RL, steel, surface mounted.

2.3 RETURN AND EXHAUST AIR GRILLES

- A. Grilles with curved horizontal face bars, fixed at 45 degrees.
  - 1. Titus 350RL, steel, surface mounted.
  - 2. Titus 350RL, steel, lay-in.

- 2.4 Registers, grilles and diffusers by Price, Nailor or Krueger of the same type, size and meeting other specified requirements may be furnished at the Contractor's option.

**PART 3 EXECUTION**

- 3.1 All steel grilles and registers shall be furnished with factory prime coat of paint. Outlets in ceilings shall be furnished with factory white finish unless otherwise noted.
- 3.2 Diffusers in ceilings shall have flush appearance and shall initially be set by Mechanical Contractor for horizontal air pattern distribution.
- 3.3 Manufacturer's drawings shall include the "K" factor for use with an Alnor velometer for each size and type of register, grille and diffuser furnished.
- 3.4 Furnish frames and trim compatible with existing ceilings.



3.5 Provide additional support hangers for grilles and registers mounted in lay-in ceiling tiles.

END OF SECTION

**SECTION 23 62 13 - AIR-COOLED CONDENSING UNIT (CHILLER WITH REMOTER EVAPORATOR)**

**PART 1 - GENERAL**

1.01 SECTION INCLUDES

- A. Condensing unit package.
- B. Remote brazed plate heat exchanger indoor evaporator.
- C. Charge of refrigerant and oil.
- D. Controls and control connections.
- E. Refrigerant piping connections.
- F. Motor starters.
- G. Electrical power connections.

1.02 RELATED SECTIONS

- A. Section 230548 – Expansion and Vibration Isolation: Placement of vibration isolators.
- B. Section 230529 - Piping Installation.
- C. Section 230700 - Piping Insulation.
- D. Section 15535 - Refrigeration Piping and Specialties.
- E. Section 250000 - Controls and Instrumentation.
- F. Section 260519 – Low Voltage Conductors and Cables

1.03 REFERENCES

- A. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.
- B. ANSI/ASHRAE 90A - Energy Conservation in new Building Design.
- C. AHRI 370 - Sound Rating of Large Refrigeration and Air-conditioning Equipment.
- D. AHRI 365- Unitary Air-Conditioning Equipment.

1.04 SUBMITTALS

- A. Submit shop drawings indicating components, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- B. Submit product data indicating rated capacities, weights, specialties and accessories, electrical nameplate data, and wiring diagrams.
- C. Submit complete wiring diagrams for the specific unit for review by engineer prior to manufacturing and installation.
- D. Submit design data indicating refrigeration and chilled water pipe sizing.
- E. Submit manufacturer's installation instructions.

1.05 OPERATION AND MAINTENANCE DATA

- A. Submit operation and maintenance data.
- B. Include manufacturer's descriptive literature, start-up instructions, installation instructions, and maintenance procedures.

1.06 HANDLING

- A. Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.
- B. Protect units on site from physical damage.

1.07 WARRANTY

- A. Provide a full parts warranty for one year from start-up or 18 months from shipment, whichever occurs first.

1.08 MAINTENANCE

- A. All work on units shall be accomplished by OEM factory trained and authorized service technicians.

1.09 ACOUSTICS

- A. Manufacturer of condensing unit shall provide outdoor sound power level at gross cooling capacity, and at significant part-load stages (for units equipped to be operated in stages). Outdoor sound shall consist of radiated sound power for each octave band from 63Hz to 8kHz. Data shall be obtained in accordance with ANSI/AHRI Standard 370.

1.10 REGULATORY REQUIREMENTS

- A. Unit shall conform to UL 1995 , CAN/CSA C22.2 NO. 236-95 for construction of condensing units and shall have cULus label affixed to unit.
  - 1. In the event the unit is not UL/CSA approved, the manufacturer shall, at his expense, provide for a field inspection by a UL representative to verify conformance to cULus standards. If necessary, contractor shall perform required modifications to the unit to comply with UL, as directed by the UL representative, at no additional expense to the Owner.
- B. Unit and installation shall comply with all requirements of the state of Ohio regarding installation of mechanical refrigeration system and equipment and meet the requirements of Ohio Mechanical Code and ASHRAE 90.1 – 2010.

1.11 SUMMARY

- A. The contractor shall furnish and install air-cooled condensing unit(s) as shown as scheduled on the contract documents. The unit(s) shall be installed in accordance with this specification and perform at the specified conditions as scheduled.

**PART 2 - PRODUCTS**

2.01 GENERAL UNIT DESCRIPTION

- A. Provide self-contained, packaged, factory-assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, subcooling circuits, and controls.

- B. Trane is the basis of design manufacturer. Air cooled scroll chillers by Daikin, York, or Carrier meeting all requirements, including efficiency, may be furnished at the contractor's option. Efficiencies noted on drawing are minimum and must be met by any manufacturer.

#### 2.02 CASING

- A. Units shall be constructed of 14-gauge welded galvanized steel frame with 14 and 16-gauge galvanized steel panels and access doors. Units shall have factory mounted, louvered, full-length steel grilles to protect the condenser coils and piping. Unit surface shall be phosphatized and finished with an air-dry paint. This air-dry paint finish shall be durable enough to withstand a minimum of 672-consecutive-hour salt spray application in accordance with standard ASTM B117.

#### 2.03 CONDENSER SECTION

- A. Condenser coils shall have all Aluminum Microchannel coils. All coils shall be leak tested at the factory to ensure pressure integrity. The condenser coil shall be pressure tested to 650 psig.
- B. Provide factory mounted, louvered, full-length steel grilles to protect the condenser coils and piping.

#### 2.04 REFRIGERANT CIRCUIT(S)

- A. Provide two circuits of 60 tons each of 410-A refrigerant on the 120 ton unit.
- B. Manufacturer shall provide and install Bleed Thermal Expansion valves and refrigerant accessories to be installed by contractor. 30% or 15% Bleed thermal Expansion valves shall be used. Quantity and size shall be based on the application. Note: Liquid line solenoids are required for all applications. Trim solenoids cannot be used.
- C. Provide Suction Service Valve for installation by contractor. Unit shall include a refrigerant shut off valve to isolate the compressor for servicing.

#### 2.05 FANS AND MOTORS

- A. Condenser Fans shall have Vertical discharge, direct drive fans with aluminum blades and zinc plated steel hubs guard on discharge. Fans shall be statically and dynamically balanced.
- B. Condenser fan motors shall be three-phase motors with permanently lubricated ball bearings, built in current and thermal overload protection and weather-tight slingers over motor bearings.

#### 2.06 COMPRESSORS

- A. Scroll compressors shall provide low vibration. Compressors shall have a completely enclosed compression chamber with no leakage paths. The compressor(s) shall be suction gas cooled, direct drive, with 3600 RPM hermetic motors. The scroll compressor shall include a centrifugal oil pump, oil level sight glass, and an oil charging valve.
- B. Motor shall be designed for across-the-line starting and suitable for a voltage utilization range of +/- 10 percent from nameplate voltage.

## 2.07 SYSTEM CONTROLS

- A. Unit Control: Factory-provided 115-volt control circuit includes fusing and control power transformer. The unit is wired with magnetic contactors for compressor and condenser motors. Three-leg circuit breakers are used for overload and short circuit protections. The unit also has high/low pressure cutouts. Charge isolation, reset relay and anti-recycle compressor timer is provided. Across- the- line start is standard.

## 2.08 MISCELLANEOUS FEATURES

- A. Provide a Low ambient option that shall allow unit operation down to 0 F through the use of fan cycling and head pressure control dampers. The control shall consist of a heavy gauge damper assembly that is modulated by an actuator. The actuator shall be controlled by a low ambient control module. All components are factory-mounted. Field installed or 80-120T units shall utilize an external damper assembly for head pressure control.
- B. Provide neoprene in shear vibration isolators. Installation of isolators shall be under the unit base to minimize transmission of unit vibrations. Isolators shall consist of a steel top plate and base completely embedded in color coded oil resistant neoprene stock. Mountings shall have a deflection of 0.250 inches
- C. Provide Hot Gas Bypass Valves. The valve shall modulate hot gas to the inlet of the evaporator when suction pressure falls below the valve adjustable set point. Electronic versions shall be available with control through temperature or pressure.
- D. The flow switch shall be provided for applications where the condensing unit is used with a remote evaporator chiller. The switch shall prohibit compressor start-up and operation, if the water flow through the chiller is not adequate.
- E. Provide a brazed plate and frame heat exchanger with rated capacity matched to condensing unit capacity and pressure ratings for refrigerant 410-A. Water side pressure rating to be 150 psig. The evaporator shall be tested to 1.1 times the refrigerant working pressure and 1.5 times the maximum allowable water side working pressure. Evaporator shall be single pass design.
- F. Provide a 5-year warranty of compressor materials.

## **PART 3 - EXECUTION**

### 3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Provide for connection to electrical service.
- C. Install units with vibration isolation.
- D. Install units on existing concrete base as indicated.
- E. Provide connection to refrigeration piping system and evaporators.

### 3.02 MANUFACTURER'S FIELD SERVICES

- A. Supply initial charge of refrigerant and oil for each refrigerant circuit.
- B. Additional refrigerant, if required within the first year, shall be added by the contractor at now additional charge to the owner.
- C. The oil, refrigerant and control system and all piping and wiring shall be checked by a qualified representative of the manufacturer before and during initial run of the unit. Operating logs shall be taken to test the operation of unit.
- D. Provide factory start up and first year labor and material warranty by the unit manufacturer. The unit manufacturer shall provide a factory trained serviceman for a period of not less than two (2) days to supervise charging and start-up of the unit and instruct the owner's maintenance personnel in the proper operation and maintenance of the units. Three (3) copies of start-up logs, part lists and operating and maintenance instructions shall be furnished to the heating and air conditioning contractor for inclusion in the operating and maintenance instructions.

### 3.03 FIELD QUALITY CONTROL

- A. Storage: Store per chiller manufacturer's written recommendation. Store chiller indoors in a warm, clean, dry palace where the chiller will be protected from weather, construction traffic, dirt, dust, water and moisture. If chiller will sit idle for more than three months, purchase log-term storage service from the manufacturer to ensure warranty coverage.

**END OF SECTION**



## SECTION 23 75 00 – AIR HANDLING UNITS

### PART 1 GENERAL

#### 1.0 REFERENCES

- A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Divisions 01 Specifications Sections, apply to this Section.
- B. UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- C. Section 23 01 05, Paragraph 1.5 - OHIO ENERGY CODE.
- D. Section 23 31 13.13 - LOW PRESSURE DUCTWORK.
- E. Section 23 75 05 AIR HANDLING UNIT FILTERS
- F. Section 23 90 13 - VARIABLE FREQUENCY DRIVES.
- G. Section 25 00 00 - TEMPERATURE CONTROLS.
- H. ANSI/AHRI Standard 410 - Forced Circulation Air-Cooling and Air-Heating Coils.
- I. ANSI/AHRI Standard 430 - Central Station Air Handling Units.
- J. ANSI/ASHRAE Standard 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- K. ANSI/ASHARE Standard 62.1 - Ventilation for Acceptable Indoor Air Quality.
- L. ANSI/ASHARE Standard 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.
- M. ANSI/NEMA MG 1 - Motors and Generators.
- N. ANSI/UL 900 - Standard for Safety Air Filter Units.
- O. AHRI Standard 260 - Sound rating of Ducted Air Moving and Conditioning Equipment.
- P. ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems.
- Q. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilation Systems.

#### 1.1 SUBMITTALS

- A. Submit under provisions of division. No equipment shall be fabricated or delivered until the receipt of approved shop drawings from the Owner or Owner's approved representative.
- B. Product Data: Literature shall be provided that indicates dimensions, operating and shipping weights, capacities, ratings, fan performance, filter information, factory supplied accessories, electrical characteristics, and connection requirements. Installation, Operation and Maintenance manual with startup requirements shall be provided.
- C. All performance data, including capacities and airside and waterside pressure drops, for components.
- D. Fan curves shall be provided for fans with the design operating points indicated. Data shall be corrected to actual operating conditions, temperatures, and altitudes.
- E. A schedule detailing necessary trap height shall be provided for each air handling unit. Schedule shall detail unit tag, unit size, appropriate trap schematic with recommended trap dimensions, and unit supplied base rail height. Contractor shall be responsible for additional trap height required for trapping and insulation beyond the unit supplied base rail height by adequate housekeeping pad.
- F. Sound data shall be provided using AHRI 260 test methods. Unit discharge, inlet, and radiated sound power levels in dB shall be provided for 63, 125, 250, 500, 1000, 2000, 4000 and 8000Hz.
- G. The AHU manufacturer shall list any exceptions to the specification.
- H. Shop Drawings: Unit drawings shall be provided that indicate assembly, unit dimensions, clearances, and connection details. Computer generated fan curves for each fan shall be submitted with specific design operation point noted.



1. Wiring diagram shall be provided with detail for power and control systems and differentiate between factory installed and field installed wiring.
2. Complete handling, installation, wiring, troubleshooting and maintenance instructions. To include full schematic diagrams for all printed circuit boards. Also include complete parts and component listing for all printed circuit boards and factory service manuals.

## **1.2 OPERATION AND MAINTENANCE DATA**

- A. Operation Data: Include instructions for starting and operating units, and describe operating limits that may result in hazardous or unsafe conditions.
- B. Maintenance Data: Include routine preventive maintenance schedule.

## **1.3 DELIVERY, STORAGE AND HANDLING**

- A. Units shall be crated for shipment prior to shipment to prevent damage during transport and thereafter while in storage awaiting installation. Crate shall be fabricated of dimensional lumber and plywood.
- B. Follow Installation, Operation and Maintenance manual instructions for rigging, moving, and unloading the unit at its final location.
- C. Unit shall be handled carefully to avoid damage to components, enclosures and finish.
- D. Unit shall be stored in a clean, dry place protected from weather and construction traffic in accordance with Installation, Operation and Maintenance manual instructions.

## **1.4 WARRANTY**

- A. Manufacturer shall provide a limited warranty for a period of 12 months from the date of equipment start up or 18 months from the date of original equipment shipment from the factory, whichever is less.
- B. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided manufacturer's written instructions for installation, operation, and maintenance have been followed.
- C. Warranty excludes parts associated with routine maintenance, such as belts and air filters.

## **1.5 QUALITY ASSURANCE**

- A. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
- B. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.
- C. Certify air handling units in accordance with AHRI Standard 430. Units shall be provided with certification label affixed to the unit.
- D. Certify air handling coils in accordance with AHRI Standard 410. Units shall be provided with certification label affixed to the unit.

## 1.6 SCOPE

- A. Provide air handling units with dimensions, arrangement and capacities as shown.
- B. Units shall be furnished complete with housing, supply air fans, exhaust fans, **variable frequency drives**, filter sections (with filters), motors, fan guards, internal fan isolation, chilled water cooling coil(s), hot water heating coil(s), drain pans and all necessary appurtenances. Units shall have insulated, hinged access doors with size and locations as required for proper access.
- C. Filters and filter racks shall be furnished separately by air cleaning system manufacturer. Coordinate with air cleaning equipment manufacturer to ensure dimensional fit with air handling units. Coordinate racks with actual manufacturer being furnished.
- D. Provide fan curves and sound power ratings with submittals.
- E. Unit shall be shipped in a "knock down" configuration for assembly in the field where necessary for installation. It is the responsibility of the HVAC Contractor and air handling unit manufacturer to ensure that the unit is shipped in sections of sufficient size to be brought into the building. Manufacturer's representative shall be on site to supervise/inspect installation of the air handling unit.

## PART 2 PRODUCTS

### 2.1 MANUFACTURER

- A. Air handling units shall be as manufactured by Aaon. Equal air handling units by Trane, or Daikin may be provided at the contractor's option.
  - 1. AHUs shall be AAON Model V3 with size and capacities as shown on the attached Air Handling Unit Schedule.
- B. Arrangements, capacities, and dimensions indicated on the drawings shall be strictly adhered to. This includes but is not limited to the unit heights and widths, access door sizes, construction type, coil velocities and pressure drops, etc., and shall include:
  - 1. Direct driven backward curved plenum supply fans.
  - 2. Double wall cabinet construction.
  - 3. Insulation with a minimum R-value of 13 hr\*ft<sup>2</sup>\*F/BTU.
  - 4. Double sloped (stainless steel in cooling coil section) drain pans, designed to ASHRAE 62.1 requirements.
  - 5. Hinged access doors with lockable handles.
  - 6. LED service lights in the control panel.
  - 7. Designed, engineered, and manufactured in the United States of America.
  - 8. All other provisions of the specifications must be satisfactorily addressed.
- C. General Description

1. Indoor air handling units shall include mixing section with dampers, filter box (filter system provided by air cleaning system manufacturer), hot water heating coil, chiller water coil, supply fans and unit control panel.
2. Unit shall have a draw-through supply fan configuration and discharge air vertically.
3. Units shall be shipped in two or more sections as necessary to fit the units into the building openings. The contractor and unit manufacturer shall coordinate shipping split requirements before the units are ordered.
4. Units shall be factory tested including leak testing of the chilled water coil, leak testing of the hot water coil, and run testing of the supply fans and factory wired electrical system. Run test report shall be supplied with the unit.
5. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
6. Unit components shall be labeled, including pipe stub outs, electrical and controls components.
7. Installation, Operation and Maintenance manual shall be supplied within the unit.
8. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
9. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

## 2.2 UNIT CONSTRUCTION

- A. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam insulated panels.
- B. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D1929-11 for a minimum flash ignition temperature of 610°F.
- C. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel and prevents exterior condensation on the panel.
- D. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
- E. Access to filters shall be through hinged access door with quarter turn handles.
- F. Access to cooling coil shall be through hinged access door with quarter turn handles.
- G. Access doors shall be flush mounted to cabinetry.
- H. Access to supply fan shall be through hinged access door with quarter turn handles.

- I. Cooling coil shall be mechanically supported above the drain pan by multiple supports that allow drain pan cleaning and coil removal.
- J. Unit shall include a 6.0-inch base.
- K. Unit shall include exterior corrosion protection which shall be capable of withstanding at least 500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
- L. Unit casing (wall/floor/roof panels and doors) shall be able to withstand up to 1.5 times design static pressure, or 8-inch w.g., whichever is less, and shall not exceed 0.0042 per inch of panel span (L/240).

### **2.3 FANS**

- A. Supply Fans
  - 1. Unit shall include direct drive, unhooded, backward curved, plenum supply fans.
  - 2. Blowers and motors shall be dynamically balanced.
  - 3. Blower and motor assembly shall be mounted on rubber isolators.

### **2.4 ELECTRICAL:**

- A. Unit shall be provided with a factory mounted control panel with separated low and high voltage control wiring.
- B. Unit shall be provided with standard power block for connecting power to the unit.
- C. Unit shall include a factory installed 24V control circuit transformer.
- D. Unit shall include high and low voltage quick connects for easy wiring at installation.
- E. Unit shall be provided with phase and brown out protection which shuts down motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.

### **2.5 DIMENSIONS**

- A. Air handling units shall conform to the dimensions as shown on the drawings.
- B. The unit manufacturer and HVAC Contractor shall coordinate shipping splits to ensure that they will fit into the building and mechanical room.

### **2.6 COILS**

- A. Chilled Water Cooling Coils
  - 1. Coil shall be certified in accordance with AHRI Standard 410 and be proof tested to 300 psig and leak tested to 200 psig air pressure under water.

2. Coil shall be designed and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
3. Coil shall have capacities, rows and fin spacing as shown on schedule.
4. Tube supports and coil casings for cooling coils shall be stainless steel.
5. All coils shall have same end connections and shall be removable from the unit housing without disassembling the unit. Location (side) of connection shall be determined by the HVAC Contractor and confirmed before ordering unit. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.
6. Coils to be furnished for water supply in the bottom and out on the top.
7. Provide stainless steel drain pan for cooling coil section.
8. Control valves shall be field supplied and field installed by the HVAC Contractor.

**B. Hot Water Heating Coils**

1. Coil shall be certified in accordance with AHRI Standard 410 and be proof tested to 300 psig and leak tested to 200 psig air pressure under water.
2. Coil shall be designed and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
3. Coil shall have capacities, rows and fin spacing as shown on schedule.
4. Tube supports and coil casings for cooling coils shall be stainless steel.
5. All coils shall have same end connections and shall be removable from the unit housing without disassembling the unit. Location (side) of connection shall be determined by the HVAC Contractor and confirmed before ordering unit. Supply and return connections shall be sweat connection. Coil connections shall be labeled, extend beyond the unit casing, and be factory sealed on both the interior and exterior of the unit casing to minimize air leakage.
6. Coils to be furnished for water supply in the bottom and out on the top.
7. Provide stainless steel drain pan for cooling coil section.
8. Control valves shall be field supplied and field installed by the HVAC Contractor.

**2.8 DAMPERS**

- A. All dampers, with shall be internally mounted. Dampers shall be premium ultra low leak and located as indicated on the schedule and plans. Blade arrangement (parallel or opposed) shall be provided as indicated on the schedule and drawings. Dampers shall be Ruskin CD60 double-skin airfoil design or equivalent for minimal air leakage and pressure drop. Leakage rate shall not exceed 3 CFM/square foot at one inch water gauge complying with ASHRAE 90.1 maximum damper leakage and shall be

AMCA licensed for Class 1A. All leakage testing and pressure ratings shall be based on AMCA Standard 500-D.

B. Refer to the AHU schedule for additional details.

## **2.8 FILTER BOX**

- A. Unit shall include a filter box sized to accommodate a field installed air cleaning/filter system.
- B. Refer to the AHU schedule for additional details.

## **2.9 CONTROLS**

- A. Motor controls shall be provided with VFD integral to unit control. Speed control signal to be provided by the BAS subcontractor. CAV units will be balanced and controlled by static pressure setpoint control.

## **2.10 ACCESSORIES**

- A. Units shall be provided with remote safety shutdown terminals for wiring to a field installed smoke detector, firestat, or building safety automatic shutdown system.

## **PART 3 EXECUTION**

### **3.01 EQUIPMENT RECEPTION**

- A. Unloading, rigging, and installation of equipment shall be done by the rigging or installation contractor.

### **3.1 INSTALLATION, OPERATION AND MAINTENANCE**

- A. Coils shall be mounted in suitable supporting frames so that coils are readily removable. Provide blank-off sections and gaskets as required to prevent air leakage around the coils.
- B. Extend piping from condensation drain pan(s) to the nearest floor drain or service sink on the floor below.
- C. Wiring shall be by the Electrical Contractor.
- D. Installing contractor shall install unit, including field installed components, in accordance with Installation, Operation and Maintenance manual instructions.
- E. Air handling units shall be installed on concrete housekeeping pads by the HVAC Contractor.
- F. Install secondary drain pans under all units. Extend secondary drain to floor drain or service sink as shown on the drawings, inside curb area. The Temperature Control Sub-Contractor shall provide a leak detection sensor in the auxiliary drain pan to shut the unit down and provide an alarm at the operator workstation if a leak condition is detected.
- G. Install supplemental filter frame support in coordination with air cleaner manufacturer's recommendations.

- H. Assemble unit sections as recommended by the Manufacturer under the supervision of the manufacturer or their representative.
- I. Manufacturer shall provide 1 day start-up and training.
- J. Start up and maintenance requirements shall be complied with to ensure safe and correct operation of the unit.

**END OF SECTION**

## **SECTION 23 75 05 - AIR HANDLING UNIT FILTERS**

### **PART 1 - GENERAL**

#### 1.1 REFERENCE

- A. SECTION 230530 - INSTALLATION OF PIPING
- B. Section 250001 - SEQUENCES OF OPERATION

#### 1.2 SCOPE

- A. Provide filters in all new air handling units provided in the project.
- B. The HVAC Contactor shall provide the necessary support structure for the filter as well as the sealed blank off panels around the filter rack to prevent air leakage around the filter rack.

### **PART 2 - PRODUCTS**

#### 2.1 FILTER RACK

- A. Filter holding frame shall be constructed of 16-gauge galvanized steel. The frame shall be assembled from two corner sections and welded to assure a rigid and durable frame assembly for built-up bank HVAC level application. Centering dimples shall be an integral part of the frame to assist in aligning final filter and prefilter if applied.
- B. Frame-to-frame installation holes shall be an integral part of the frame, two holes on each vertical and three holes on top and bottom. The top of the frame shall be identified with etching.
- C. The frame shall include eight integral corrosion resistant compression tabs, four on each horizontal member, to facilitate filter installation without the use of tools or other fasteners.
- D. A 3/4" filter sealing flange shall be an integral component of the holding frame. All corners shall be flush mitered.
- E. A replaceable filter-to-frame sealing gasket shall be installed on the flange to prevent air bypass and ensure that the filter seats securely against the sealing flange. The gasket shall include an overlapping configuration at each corner to prevent air bypass at each of the corners of the frame.
- F. Manufacturer shall provide evidence of facility certification to ISO 9001:2008.
- G. Rack Size and Filter Quantities shall be coordinated with the AHU manufacturer.

#### 2.2 FILTERS (AHU-5A, 5B, 6A, 6B)

- A. Provide non-ionizing, polarized media electronic air cleaners.
- B. Certifications: The Air Cleaner shall have been tested and meet UL Standard 867 and CSA Standard C22.2 No. 187-M19986 for Electrostatic Air Cleaners.
- C. Operation: The Air Cleaner shall have an active electrostatic field that polarizes a dielectric media. It shall not ionize airborne particles or produce ozone.



- D. Laboratory Testing Performance: Using the ASHRAE 52.2 protocol with carbon black in the test dust, the Air Cleaner shall test at MERV 13. Using the ASHRAE 52.2-NC protocol (with no carbon in the loading dust), the Air Cleaner shall test at MERV 15. A 24"x 24"x 29.5" deep module section shall increase in resistance no more than 0.25" w.g. with a dust loading of 2,855 grams. As installed, it shall have a clean static pressure drop of less than 0.30" w.g. at 500 feet per minute. Any substitute Air Cleaner must meet these MERV ratings, static pressures and loading characteristics. The Air Cleaner manufacturer must provide testing from an approved ASHRAE test lab to verify MERV ratings, operational performance and loading performance.
- E. Field Performance: The Air Cleaner manufacturer shall produce at least two documented installation references, including client contact information with the following criteria:
- a. Air Cleaners shall have operated continuously for a minimum of 2.5 years with no pre-filtration and without media change and achieved an increase of less than .2 inches of static pressure at a face velocity of ~500fpm, in an urban environment. Air cleaner installations must be greater than 10,000 cfm and serving office and/or hospital space.
  - b. In an urban environment, Air Cleaners must have demonstrated the ability to achieve indoor ultra-fine particle and black carbon levels that are up to 94% lower than the concentrations in the air outside the building. Outdoor air levels brought into in the building must be based on the ASHRAE Standard 62 Ventilation Rate Procedure.
  - c. Air Cleaners shall have a documented ability to reduce TVOC levels by 50-60% in a single pass. Air Cleaners must have already been in service for over 90 days. Tests must be administered by an independent, third-party and readings must be taken immediately upstream and downstream of the Air Cleaning system over a minimum period of 24 hours.
  - d. Air Cleaners shall have been tested in an installation according the ASHRAE 26 protocol on a quarterly basis over the course of a year. The Air Cleaners must have met the required efficiency in each test.
- F. Construction: The Air Cleaner modules shall consist of four or six individual Air Cleaner Panels that are nominally 1" in depth, arranged in V's within the module. The construction of the Air Cleaner frame and screens shall be aluminum, and the module side panels and attachment flanges shall be of galvanized steel. The Air Cleaner modules and each component thereof must have a positive seal where necessary to prevent bypass of unfiltered air.
- G. Electronics: The high voltage Powerheads shall require 24 volts AC input and have a 9.5kV DC output. The Powerheads must be fully potted and connected in parallel.
- H. Control Panel: The 24VAC power supply must contain a UL or CSA certified transformer, class "2" type, which shall permit one side of the secondary output (24V) to be attached to electrical ground. A direct readout filter gauge shall be installed in the Unit Control Panel.
- I. Filter Media: Each Air Cleaner shall have a disposable and recyclable media pad with a minimum of a class "2" fire rating. These shall have a positive seal in the overall module assembly to prevent the bypass of unfiltered air.
- J. Configuration: The Air Cleaners will be arranged in pre-fabricated module assemblies nominally 12" or 18" in height, of varying widths up to 48", and either 24" or 29.5" deep in direction of airflow. The number of modules and width shall be such that the face velocity thru the filter bank shall be no more than 550 fpm. The V8 modules will be permanently mounted in the air handler and secured with vertical posts. The Air Cleaner module bank will be flashed and sealed. The air

handler will be configured so as to allow front (or rear, but must be specific) access for media changes of the V8 assembly. There must be at least 24" of space for service and media change-out.

- K. Electrical Connection: The air handler manufacturer shall provide a fully operational filter section for field connection and field electrical tie-in. All 24VAC electrical and control wiring integral to the Air Cleaner modules and Control Panel, including the access door interlocks, are to be provided by the Air Cleaner manufacturer for connection in the field or factory. All line voltage connections and wiring are the responsibility of the contractor.
- L. Maximum Allowable Static Pressure: To minimize energy consumption, the AHU fan system has been designed for specific pressure drop through the Air Cleaning system. The fan system is designed for a maximum of 0.70" w.g. when the filters are dirty.
- M. Construction and Start-up: If the air handler is operating during construction, the contractor shall protect the Air Cleaner bank using roll or other media with a minimum rating of MERV 9. These should be removed after 30 days from initial startup.
- N. Filter basis of design is Dynamic Air Quality Solutions V8.

#### 2.4 FILTERS (EAHU-H1, H2, L1, L2)

- A. Air filters shall be medium efficiency ASHRAE pleated panels consisting of synthetic media, welded wire media support grid, and beverage board enclosing frame.
- B. Filter media shall be a synthetic blend, lofted to a uniform depth of 0.15", and formed into a uniform radial pleat.
- C. A welded wire grid, spot-welded on one-inch centers and treated for corrosion resistance shall be bonded to the downstream side of the media to maintain radial pleats and prevent media oscillation.
- D. An enclosing frame of no less than 28-point high wet-strength beverage board shall provide a rigid and durable enclosure. The frame shall be bonded to the media on all sides to prevent air bypass. Integral diagonal support members on the air entering and air exiting side shall be bonded to the apex of each pleat to maintain uniform pleat spacing in varying airflows.
- E. The filter shall have a Minimum Efficiency Reporting Value of MERV 8 when evaluated under the guidelines of ASHRAE Standard 52.2. It shall also have a MERV-A of 8 when tested per Appendix J of the same standard. ISO 16890 rating is ePM10 50
- F. Initial resistance to airflow shall not exceed 0.27", 0.31" or 0.27" w.g. at an airflow of 350, 500 or 500 fpm on 1", 2" or 4" deep models respectively.
- G. The filter shall be listed by Underwriters Laboratories as UL Class 900.
- H. Manufacturer shall guarantee the integrity of the filter pack to 2.0" w.g.
- I. Filter basis of design is Camfil Farr 30/30.

- 2.5 Two (2) complete sets of filters shall be furnished by the air handling unit manufacturer. Filters shall not be shipped to the jobsite until construction is complete and the units are ready to have the first set of clean

filters installed. Furnish the other set as a spare to the HVAC Contractor when the project is complete. Provide temporary filters for use during construction.

**PART 3 - EXECUTION**

- 3.1 Filter rack shall be mounted in air handling unit so that filters are readily removable. Provide blank-off sections and gaskets as required to prevent air leakage around the filter and filter racks.

**END OF SECTION**

## SECTION 23 82 39.16 - HOT WATER HORIZONTAL PROJECTION UNIT HEATERS

### PART 1 GENERAL

#### 1.1 REFERENCE

- A. Drawings and general provisions of the Contractor, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Section 23 01 05, Paragraph 1.5 - OHIO ENERGY CODE
- C. Section 23 05 13 - ELECTRICAL WORK
- D. Section 25 00 00 - TEMPERATURE CONTROLS

#### 1.2 SUBMITTALS

- A. Shop Drawings: Include overall dimensions capacities and weights shown; conduit and piping entrance locations and requirements; nameplate legends add the following product data.
  - 1. Complete wiring diagrams.
  - 2. Complete handling, installation, wiring, troubleshooting and maintenance instructions. Also to include complete parts and component listing and factory service manuals.

#### 1.3 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Include instructions for starting and operating units, and describe operating limits that may result in hazardous or unsafe conditions.
- B. Maintenance Data: Include routine preventive maintenance schedule.

#### 1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle product to site under provisions of Division 01.
- B. Accept units on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instruction. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure and finish.

#### 1.5 MAINTENANCE SERVICE

- A. Furnish service and maintenance of units for one year from Date of Occupancy.

#### 1.6 SCOPE

- A. Furnish and install unit heaters and appurtenances as shown on the drawings.

#### 1.7 QUALITY ASSURANCE

- A. Comply with ARI 440 for testing and rating units.

- B. Comply with ASHRAE 33 for testing air coils.
- C. Comply with NFPA 70 for components and installation.
- D. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in the National Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

## **PART 2 PRODUCTS**

- 2.1 Hot water horizontal projection unit heaters shall be furnished with gray enamel steel casing, flat single serpentine coil, aluminum fan, horizontal adjustable louvers and adjustable louver fins.
  - A. Manufacturer and Model – Sterling Model HS
- 2.2 Capacities based on 130°F. entering water, 20°F. drop and 65°F. entering air temperature.
- 2.3 Motors shall be totally enclosed with permanently lubricated, sealed ball bearing, fractional horsepower, 120 volt, 60 cycle, single phase with thermal overload protection, automatic reset.
- 2.4 Units shall be furnished with horizontal and vertical discharge louvers (4-way). Casing shall be enamel finished steel.
- 2.5 Unit mounted sensor and two-position, electric automatic control valves for units shall be furnished by the Temperature Control Sub-Contractor.
- 2.6 Unit heaters by Trane, Carrier, Modine, Vulcan, of the same type, may be furnished at the Contractor's option.

## **PART 3 EXECUTION**

- 3.1 Power wiring by the Electrical Contractor.
- 3.2 Support all units on rods from above and spring vibration isolators. Furnish auxiliary steel where required.
- 3.3 Controls provided by the Temperature Control Sub-Contractor.

## **END OF SECTION**

## SECTION 23 90 13 - VARIABLE FREQUENCY DRIVES

### PART 1 GENERAL

#### 1.1 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NEMA ICS 3.1 - Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable Speed Drive Systems.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

#### 1.2 SUBMITTALS

- A. Submit under provisions of division.
- B. Shop Drawings: Include front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; nameplate legends add the following product data.
  - 1. Complete wiring diagrams. Wiring diagrams to include components within the speed controller enclosure.
  - 2. Overall system efficiencies at 1/4, 1/2, 3/4 and full motor load, including the effect of line reactors.
  - 3. Complete handling, installation, wiring, troubleshooting and maintenance instructions. To include full schematic diagrams for all printed circuit boards. Also to include complete parts and component listing for all printed circuit boards and factory service manuals.
  - 4. Actual calculated nameplate ratings for both input and output currents reflecting specific installation.
  - 5. Displacement and distortion power factors.

#### 1.3 OPERATION AND MAINTENANCE DATA

- A. Operation Data: Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
- B. Maintenance Data: Include routine preventive maintenance schedule.

#### 1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters' Laboratories, Inc.

#### 1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store, protect and handle product to site under provisions of division.

- B. Accept controllers on site in original packing. Inspect for damage.
- C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle in accordance with manufacturer's written instruction. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure and finish.

#### 1.6 MAINTENANCE SERVICE

- A. Furnish service and maintenance of controller for one year from Date of Contract Completion.

#### 1.7 SCOPE

- A. Provide Yaskawa Solid State variable frequency controllers to control the following:
  - 1. Chilled Water Pumps
  - 2. Heating Hot Water Pumps
  - 3. DOAS-1 thru DOAS-3 Supply Fan
  - 4. DOAS-1 & DOAS-2 Return Fan
- B. Refer to the equipment schedules on the HVAC drawings for the VFD quantities and motor sizes.
- C. All units shall be supplied with manual electric by-pass to permit constant speed operation from AC line.
- D. All units provided for this project shall be on the same type and manufacturer.
- E. Aegis motor shaft grounding rings shall be provided for each motor served by a variable frequency drive.

### PART 2 PRODUCTS

#### 2.1 VARIABLE FREQUENCY DRIVES

- A. Furnish and install Yaskawa solid state variable frequency drives to vary the speed of the indicated 208 volt, 3 phase induction motors. System shall be microprocessor based, fully transistorized with a conservatively rated 3 phase, full wave diode bridge input and a PWM sine-coded output waveform. The input diode bridge will offer complete immunity against voltage dips, line noise and harmonics. The output transistors must be of the IGBT type (Insulated Gate Bipolar Transistor) to facilitate noiseless motor operation. The VFD's will be tested and rated for a minimum of 28 years Mean Time Between Failure (MTBF).
- B. The speed controller inverter to be suitable for motors driving fans and pumps. Rectifier to be full wave type. Displacement power factor to be 0.98 minimum. Maximum total harmonic distortion (THD) to be limited to 5 percent.
- C. Input power is from a 208 volt, 3 phase, 4 wire, 60 Hz distribution system. Output power to the motor at 60 Hz to be nominally 208 volts.

- D. Controller to be designed for continuous operation at any speed (frequency) within the specified frequency range. Controller design to be such that openings of motor leads and operation of protective features do not cause component failures. Linear speed control to be from 10 to 100 percent of maximum speed, unaffected by input voltage changes of plus or minus 10 percent rated voltage.
- E. Controller to operate satisfactorily in ambient temperatures from 32°F to 104°F (0°C to 40°C). Controller to be equipped with mechanical means for cooling components and to handle operating in a dirty environment.
- F. Output frequency to remain stable (at its operating point) in spite of input voltage, input frequency and temperature variations within the specified ranges.
- G. Controller to provide for "soft" start, with adjustable starting frequency.
- H. Provide the following features:
1. Frequency range 6 to 60 Hz output to the motor, in proportion to 0-10 volt DC or 4-20 mA signal input to the controller.
  2. Self-contained unit in a NEMA 1 enclosure with gasketed doors and clear vision panel in each door to display LED indicators, including bypass filters, circuit breaker
  3. Interfacing devices integral with the controller and connected.
  4. Adjustable devices to positively limit the lower frequency (range 6 to 8 Hz minimum) and upper frequency (range 50 to 60 Hz minimum).
  5. All Pilot lights to be LED type
  6. Internal switches for "operate-service" select, output volts/hertz ratio, coast or ramp to start, and set point operation.
  7. Provide LED indicator for ground fault indication.
- I. Additional features:
1. Analog output signal: A voltage from 0 to 10 volt D.C., proportional to either output Hz, output voltage, or output amps.
  2. LED status indicators for power on, enable trip, and LED's to indicate supplies are operating properly.
  3. Auxiliary contacts with single pole, double throw contacts each rates 1 ampere at 115 volt AC for run indication, fault indication and bypass mode.
  4. Provide input DC choke or AC line reactors.
- J. Protective and miscellaneous features, to include:
1. Integral fuses as required to protect DC bus.
  2. Power surge and spike protection (MOV's).



3. Output current limiting, without tripping by momentary overloads.
4. Instantaneous overcurrent tripping on phase to phase short circuits, high overloads and ground faults.
5. Undervoltage tripping on power or phase loss.
6. Overvoltage tripping.
7. Overtemperature tripping.
8. Visual indication of tripping causes (current limit, instantaneous overcurrent trip, undervoltage, overvoltage).
9. Overtemperature, decelerating limit.
10. Speed indicator.
11. Input molded case, thermal magnetic circuit breaker with through door interlock, lockable in open position.
12. DC injection breaking before start.
13. Hand-Off-Automatic selector switch.
14. Integral motor overload protection for the three legs, manually resetting bimetallic or eutectic alloy design, heaters sized for the motor.
15. A spare set of three fuses of each type and ampere rating.
16. Sets of dry form C contacts, actuated whenever the controller is operating the motor; refer to control CM drawings for quantities, and use.
17. Compliance with IEEE 519 latest issue; provide filtering necessary to abate electrical noise.
18. Field adjustment devices for current limit, motor overload, acceleration rate, deceleration rate, maximum speed, minimum speed, speed input and offset gain.
19. Remote start/stop input terminals used to start the drive from the DDC system shall also be common to both the drive and the bypass. Provide quantity of drive and bypass status contacts as shown.
20. DDC interface to allow the VFD to communicate all points to Building Automation System. Coordinate requirements with the (Temperature Control) CM.

## 2.2 NAMEPLATES

- A. Provide nameplates on all devices specified in this section.

- 2.3 Variable Frequency Drives by ABB, or Allen Bradley of the same type, size, capacity and meeting other specified requirements may be furnished at the Contractor's option.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Verify that surface is suitable for controller installation.

#### **3.2 INSTALLATION**

- A. Install controller where indicated, in accordance with manufacturer's written instructions and NEMA ICS 3.1.
- B. Tighten accessible connections and mechanical fasteners after placing controller.
- C. Provide neatly typed label inside each motor controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

#### **3.3 FIELD QUALITY CONTROL**

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.

#### **3.4 ADJUSTING**

- A. Make final adjustments to installed drive to assure proper operation of fan system. Obtain performance requirements from installer of driven loads.

#### **3.5 CLEANING**

- A. Touch up scratched or marred surfaces to match original finish.

#### **3.6 DEMONSTRATION**

- A. Demonstrate operation of controllers in automatic and manual modes.

#### **3.7 FIELD TESTS**

- A. Check control and interlocking wiring for proper operation, in the presence The University and the Construction Manager.

#### **3.8 START-UP AND TRAINING**

- A. Manufacturer shall provide one (1) day for start-up and training for the VFDs.

#### **3.9 WIRING**

- A. Each unit to be complete with all interconnecting wiring and connections between components within unit and to terminal board for connection to remote devices. Each wire to have an identifying number at each end.
- B. Terminal Board: Each unit to be provided with terminal boards completely accessible from the front by which line, load, and control connections for unit may be made and disconnected. Each terminal board to have all terminals clearly marked and all wiring between terminals to be provided, including connections to all extra and unused terminals on auxiliary contacts, relays, and control devices, etc.

3.10 TESTING AND START-UP

- A. Upon completion of installation, including piping and electrical connections, each component of each speed control device and its driven fans to be inspected, tested, adjusted, programmed, etc. and placed in operation by a factory trained service technician employed by the VFD manufacturer. Manufacturer to provide competent, well-trained supervisor to instruct the University's operating personnel in the proper maintenance and care of the equipment. Instruction period, exclusive of installation and start-up time, to consist of one two-hour period for all equipment specified in this section of specification.

**END OF SECTION**

## SECTION 23 91 13 - HVAC COMMISSIONING

### PART 1 – GENERAL

#### 1.1 SUMMARY

- A. Commissioning is a systematic process of ensuring that applicable building systems perform according to the design intent and the owner’s operational needs. The commissioning process encompasses and coordinates the traditionally separate functions of system documentation, equipment startup, control system calibration, testing and balancing, performance testing, and training.
- B. This section includes administrative and procedural requirements for the third party commissioning process to supplement other commissioning process activity sections and sections in Division 23 that specify testing of components, systems and assemblies.
- C. Related Sections include the following:
  - 1. Division 1 section “General Commissioning Requirements” for general administrative and procedural requirements for the commissioning process.
  - 2. Division 22 “Plumbing Commissioning” for Plumbing commissioning requirements.
- D. The HVAC, Controls and Test and Balance Contractors shall provide labor and materials to assist the Commissioning Team in commissioning of the Cooling, Heating, Air Conditioning and Ventilation systems.

#### 1.2 SCOPE

- A. The Contractor shall provide labor and materials to assist the Commissioning Team in commissioning of the Mechanical systems/equipment.
- B. Mechanical systems and equipment to be commissioned are as follows:
  - 1. Air Handling Units
  - 2. Return Air Fans
  - 3. Exhaust Fans
  - 4. Horizontal Projection Unit Heaters
  - 5. VAV boxes
  - 6. Finned Radiation
  - 7. All new and modified BAS Control Graphics

#### 1.3 QUALITY ASSURANCE

- A. Test Equipment Calibration Requirements: Contractors will comply with test manufacturer’s calibration procedures and intervals. Recalibrate test instruments immediately after instruments have been repaired resulting from being dropped or damaged. Affix calibration tags to test instruments.

## **PART 2 – PRODUCTS**

### **2.1 TEST EQUIPMENT**

- A. All standard testing equipment required to perform startup, initial checkout and functional performance testing shall be provided by the Contractor for the equipment being tested. The HVAC contractor shall ultimately be responsible for all standard testing equipment for the mechanical systems and controls systems in Division 23.
- B. Special equipment, tools and instruments (specific to a piece of equipment and only available from vendor) required for testing shall be included in the base bid price and left on site, except for stand-alone data logging equipment.
- C. Proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not, shall be provided by the manufacturer of the equipment. Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed. Proprietary test equipment (and software) shall become the property of Ohio University upon completion of the commissioning process.
- D. All testing equipment shall be of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified in the Specifications. If not otherwise noted, the following minimum requirements apply: Temperature sensors and digital thermometers shall have a certified calibration within the past year to an accuracy of 0.5°F and a resolution of + or - 0.1°F. Pressure sensors shall have an accuracy of + or - 2.0% of the value range being measured (not full range of meter) and have been calibrated within the last year.

## **PART 3 – EXECUTION**

### **3.1 MECHANICAL PIPING AND SHEET METAL CONTRACTOR(S) DUTIES**

- A. Coordination and Scheduling
  - 1. Coordinate and ensure cooperation and participation of all trades associated with mechanical contract work, such as sheet metal, test and balance, and controls.
- B. Manufacturer's Factory Testing Certificates
  - 1. Collect testing certificates for all factory-tested items. Factory testing may include Functional Performance Testing, acoustic vibration testing, etc. Submit a copy of all testing certificates to the Commissioning Authority.
- C. Punch Listing
  - 1. Develop and execute punch list of mechanical-related work prior to any A/E review or punch list activities.
  - 2. Address A/E punch list items before Functional Performance Testing.
- D. Pre-Functional Checks
  - 1. Contractor will assist the Commissioning Authority in completing pre-functional checks of all installed equipment and systems.
- E. Equipment and System Startup and Verification

1. Startup of equipment and systems occurs after all preliminary testing activity (including manufacturer's check-start-tests and Pre-Functional Checks) have been successfully completed. Contractor will submit a full startup and checkout procedure, using manufacturer's and Contractor's startup procedures, for all commissioned equipment and systems 2 weeks in advance of anticipated startup.
  2. Contractor will provide skilled technicians to execute starting of equipment, and ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
  3. Contractors will coordinate and ensure cooperation and participation of manufacturers in check, test, and start (CTS) of equipment related to a system (such as a pump) or an entire system (such as an R.O. System). Manufacturer's CTS procedures take priority over other CTS procedures unless otherwise directed by A/E.
  4. Perform and clearly document all completed startup and system operational checkout procedures. Documentation shall be submitted to the Commissioning Authority.
- F. Test and Balance
1. A certified Test and Balance (TAB) Contractor will perform test and balancing.
  2. Assist and cooperate with the Test and Balance Contractor (TAB) by:
    - a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of testing and balancing and commissioning, as required.
    - b. Providing sheaves and belts that may be required.
    - c. Providing test holes in ducts and plenums where directed by the TAB Contractor to allow air measurements and air balancing. Provide approved plug.
    - d. Provide temperature and pressure taps according to Division 15 Sections for TAB and commissioning testing.
    - e. List and clearly identify on as-built drawings the locations of all airflow stations and duct static pressure sensors.
- G. Functional Performance Testing
1. Perform Functional Performance Testing under the direction of the Commissioning Authority. The Commissioning Authority will assist and witness all Functional Performance Testing. Additional testing will be the responsibility of the HVAC Contractor.
  2. Assist the Commissioning Authority in interpreting the monitoring data, as necessary. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  3. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Authority and the E/A and retest the equipment. Make necessary adjustments to the O&M Manuals and as-built drawings following Functional Performance Testing.
  4. Perform seasonal and/or deferred Functional Performance Testing where applicable under the direction of the Commissioning Authority. The Commissioning Authority will witness all seasonal and/or deferred Functional Performance Testing. Make necessary adjustments to the O&M Manuals and as-built drawings following seasonal and/or deferred Functional Performance Testing.

H. Commissioning Issues Logs

1. The Commissioning Authority prepares a formal and ongoing Commissioning Issues Log of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process. The Contractor, along with the General Contractor and A/E, is responsible for resolving issues placed on the log that relate directly to the Contractor's work in a timely manner.
2. The Commissioning Team will revisit issues placed on the Commissioning Issues Log by the Commissioning Authority and/or the Commissioning Team one (1) time to verify that the proper corrections have been made. The Owner may reserve the right to deduct from the Contractors' contract costs associated with additional revisits required for outstanding issues.

3.3 TEST AND BALANCING (TAB) CONTRACTOR DUTIES

A. Qualifications

1. Contractor will submit to the Commissioning Authority the qualifications of the site technicians for the project 6 weeks prior to starting testing and balancing. Contractor will include a list of personnel and their certifications.

B. Coordination and Scheduling

1. Contractor will assist in coordination and ensure cooperation and participation with of all trades associated with mechanical contract work, sheet metal, and test and balance, and controls.

C. Test and Balancing Plan

1. Submit the TAB procedures for review and acceptance by the A/E and the Commissioning Authority. This plan will include:
  - a. Certification that the TAB Contractor has reviewed the Contract Documents and the systems to sufficiently understand the design intent for each system.
  - b. An explanation of the intended use of the building automation system. The Controls Contractor will comment on the feasibility of the plan.
  - c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with data cells to be gathered for each.
  - d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
  - e. Final test report forms to be used.
  - f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch/sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using airflow straighteners or relocating flow stations and sensors will be discussed.
  - g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, and formulas to be used.
  - h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return (RA) pitot traverse, SA or RA flow stations.)
  - i. The identification and types of measurement instruments to be used and their most recent calibration date.

- j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures; provide methods to verify this.
  - k. Confirmation that TAB Contractor understands the outside air ventilation criteria under all conditions.
  - l. Details of whether and how minimum outside air cfm will be verified and set, and for what level (total building, zone, etc.).
  - m. Details of how building static and exhaust fan/relief damper capacity will be checked.
  - n. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.
  - o. Details regarding specified deferred or seasonal TAB work.
  - p. Details of any specified false loading of systems to complete TAB work.
  - q. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.
  - r. Details of any required interstitial cavity differential pressure measurements and calculations.
  - s. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).
  - t. Plan for formal progress reports (scope and frequency).
  - u. Plan for formal deficiency reports (scope and frequency, and distribution).
2. Attend the TAB review meeting prior to the start of TAB work to discuss the TAB plan and procedures.
- D. Test and Balance Procedures
- 1. TAB field technicians shall keep a running log of events and issues. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests, and lists of completed tests to the General Contractor and the Commissioning Authority at a minimum of twice a week.
  - 2. Contractor shall communicate in writing to the Controls Contractor all set point and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.
  - 3. Contractor shall submit a draft handwritten TAB report within 2 weeks of completion to the A/E and the Commissioning Authority. The report will contain a full explanation of methodology, assumptions and results in a clear format with designations for all uncommon abbreviations and column headings. A reduced size drawing of the mechanical system showing the location where each reading was taken, with designations corresponding to the text in the report, must be included. The report should follow the most rigorous reporting recommendations by AABC, NEBB, or ASHRAE Standard 11.
  - 4. After completion of the TAB work, submit the final TAB report for review and approval.
- E. Punch Listing
- 1. Develop and execute punch list of mechanical-related work prior to any A/E review or punch list activities.
  - 2. Address A/E punch list items before Functional Performance Testing.
- F. Functional Performance Testing



1. Participate in Functional Performance Testing under the direction of the Commissioning Authority. The Commissioning Authority will witness all Functional Performance Testing.
2. Assist the Commissioning Authority in interpreting the monitoring data, as necessary. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
3. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Authority and the A/E and retest the equipment. Make necessary adjustments to the O&M Manuals and as-built drawings following Functional Performance Testing.
4. Perform seasonal and/or deferred Functional Performance Testing where applicable under the direction of the Commissioning Authority. The Commissioning Authority will witness all seasonal and/or deferred Functional Performance Testing. Make necessary adjustments to the O&M Manuals and as-built drawings following seasonal and/or deferred Functional Performance Testing.

G. Issues Logs

1. The Commissioning Authority prepares a formal and ongoing Commissioning Issues Log of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process. The Contractor, along with the General Contractor and Owner’s Representative, is responsible for resolving issues placed on the log that relate directly to the Contractor’s work.
2. The Commissioning Team will revisit issues placed on the Commissioning Issues Log by the Commissioning Authority and/or the Commissioning Team one (1) time to verify that the proper corrections have been made. The Owner may reserve the right to deduct from the Contractors’ contract costs associated with additional revisits required for outstanding issues.

H. Additional Duties

1. Refer to Division 1 Section “Commissioning” for general administrative and procedural requirements for the commissioning process.

3.4 CONTROLS CONTRACTOR DUTIES

A. Coordination and Scheduling

1. Contractor will assist in coordination and ensure cooperation and participation with of all trades associated with mechanical contract work, such as piping, sheet metal, and test and balance, and controls.

B. Pre-Functional Checks

1. Contractor will assist the Commissioning Authority in completing pre-functional checks of all installed equipment and systems.

C. Sequences of Operation Submittals

1. The Controls Contractor's submittals of controls drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specification. They shall include:
  - a. Overview narrative of the system generally describing its purpose, components, and function.
  - b. All interactions and interlocks with other systems.
  - c. Detailed delineation of control between any packaged controls and the Building Automation System, listing the points the Building Automation System (BAS) monitors only and which BAS points are control points and are adjustable.
  - d. Written sequences of control for packaged controlled equipment. (Equipment manufacturer's stock sequences may be included, but will generally require additional narrative.)
  - e. Startup sequences.
  - f. Warmup mode sequences.
  - g. Normal operating mode sequences.
  - h. Unoccupied mode sequences.
  - i. Shutdown sequences.
  - j. Capacity control sequences and equipment staging.
  - k. Temperature and pressure control: setbacks, setups, resets, etc.
  - l. Detailed sequences for all control strategies, eg., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
  - m. Effects of power or equipment failure with all standby component functions.
  - n. Sequences for all alarms and emergency shutdowns.
  - o. Seasonal operational differences and recommendations.
  - p. Initial and recommended values in list format for all adjustable settings, set-points, and parameters that are typically set or adjusted by the operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
  - q. Schedules, if known.
  - r. All sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.
  - s. List of all alarms and their priorities.
2. Contractor shall keep the A/E and Commissioning Authority informed of all changes to this list during programming and setup.

D. Control Drawings Submittal

1. The Control Drawings submittal shall include:
  - a. A key to all abbreviations.
  - b. Graphic schematic depictions of the systems and each component.
  - c. Schematics, which will include the system and component layout of any equipment that the control system monitors, enables, or controls, even if the equipment is primarily controlled by packaged or integral controls.
  - d. A full points list with at least the following included for each point:
    - 1) Controlled system
    - 2) Point abbreviation
    - 3) Point description – DB temp, airflow, etc.
    - 4) Display unit

- 5) Control point or set-point (Yes/No) – Point that controls equipment and can have its set-point changed (OSA, SAT, etc.)
  - 6) Monitoring point (Yes/No) – Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
  - 7) Intermediate point (Yes/No) – Point whose value is used to make a calculation that then controls equipment (space temperatures that are averaged to a virtual point to control reset).
  - 8) Calculated point (Yes/No) – “Virtual” point generated from calculations of other point values.
2. Contractor shall keep the A/E and Commissioning Authority informed of all changes to this list during programming and setup.
- E. Punch Listing
1. Develop and execute punch list of mechanical-related work prior to any Architect/Engineer review or punch list activities.
  2. Address Architect/Engineer punch list items before Functional Performance Testing.
- F. Functional Performance Testing
1. Participate in Functional Performance Testing under the direction of the Commissioning Authority. The Commissioning Authority will witness all Functional Performance Testing.
  2. Assist the Commissioning Authority in interpreting the monitoring data, as necessary. Assist in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.
  3. Correct deficiencies (differences between specified and observed performance) as interpreted by the Commissioning Authority and the A/E and retest the equipment. Make necessary adjustments to the O&M Manuals and as-built drawings following Functional Performance Testing.
  4. Perform seasonal and/or deferred Functional Performance Testing where applicable under the direction of the Commissioning Authority. The Commissioning Authority will witness all seasonal and/or deferred Functional Performance Testing. Make necessary adjustments to the O&M Manuals and as-built drawings following seasonal and/or deferred Functional Performance Testing.
- G. Commissioning Issues Logs
1. The Commissioning Authority prepares a formal and ongoing Commissioning Issues Log of deficiencies, problems and concerns – and their resolution – raised by members of the Commissioning Team during the Commissioning Process. The Contractor, along with the General Contractor and Owner’s Representative, is responsible for resolving issues placed on the log that relate directly to the Contractor’s work.
  2. The Commissioning Team will revisit issues placed on the Commissioning Issues Log by the Commissioning Authority and/or the Commissioning Team one (1) time to verify that the proper corrections have been made. The Owner may reserve the right to deduct from the Contractors’ contract costs associated with additional revisits required for outstanding issues.

**END OF SECTION**

## **SECTION 23 92 10 - MECHANICAL ALTERNATES**

### **PART 1 - GENERAL**

#### 1.1 REFERENCE

- A. Section 23 18 29.13 – Humidifiers (Electric)
- B. Section 23 75 05 – Air Handling Unit Filtration

#### 1.2 SCOPE

- A. Separate prices for individual items specified herein must be provided. If separate prices are not provided, the Bid will not be considered.

#### 1.3 ALTERNATE H-1: Provide and install new DX chiller CH-1.

- A. Bidders shall state the amount to be ADDED TO the Base Bid for providing and installing the new chiller CH-1 as shown on the drawings. Equipment consists of new 120 Ton Air Cooled condensing unit and remote plate and frame evaporator located in pump room. Provide new chilled water pump and controls to coordinate operation with existing 120 Ton chiller CH-2.
- B. Alternate bid shall include removal of existing chiller CH-1 and existing pump P-4. Also include patching of openings, new louvers for ventilation and a new refrigerant monitor system.

#### 1.4 ALTERNATE H-2: Provide and install electric humidifiers with duct mounted dispersion tubes.

- A. Bidders shall state the amount to be ADDED TO the Base Bid for providing and installing new electric humidifiers H-9, H-1, H-11, and H-12, for museum gallery duct zones where shown and noted on the drawings and as described in the referenced specifications.

### **PART 2 - PRODUCTS**

As specified in HVAC specification sections on pumps, chillers, humidifies and on equipment notes on the drawings.

### **PART 3 - EXECUTION**

- 3.1 Any modification or changes of any description required from the drawings or specifications, made necessary by the use of alternate equipment in lieu of the specified equipment in the Base Specifications, including work involving other trades, shall be the responsibility of this Contractor and the cost thereof shall be included in his Bid on this Alternate.
- 3.2 Alternate equipment shall meet all requirements, including space requirements, specified in the Base Specifications.

### **END OF SECTION 23 92 10**

OHIO UNIVERSITY  
OHIO MUSEUM COMPLEX  
LIN HALL HVAC

CONSTRUCTION DOCUMENTS  
SEPTEMBER 9, 2024  
OU PROJECT 23002

## SECTION 25 00 00 – TEMPERATURE CONTROLS

### 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. Refer to Electrical Drawings for specific requirements as they relate to Control Diagrams.
- C. Section 23 01 05 - HVAC GENERAL PROVISIONS
- D. Section 23 05 53 - TAGGING AND CODING
- E. Section 23 05 93 - TESTS AND ADJUSTMENTS
- F. Section 23 21 23.13 - INLINE PUMPS
- G. Section 23 33 13 -DAMPERS
- H. Section 23 21 23.16 - END SUCTION PUMPS
- I. Section 23 36 16 - MEDIUM PRESSURE VAV BOXES
- J. Section 23 90 13 - ADJUSTABLE FREQUENCY DRIVES
- K. Section 23 99 00 - HVAC COMMISSIONING
- L. Section 239210 - HVAC ALTERNATES
- M. Section 25 00 01 - SEQUENCE OF OPERATION FOR HVAC CONTROLS
- N. Division 26 Electrical Specifications

#### 1.2 SCOPE

- A. The overall purpose of this specification is to provide the owner (Ohio University) a complete Direct Digital Control (DDC) Temperature Control System to automatically control the operation of the entire Heating, Ventilating and Air Conditioning System and monitor and/or control auxiliary systems, for new and/or renovated buildings. The new Building Automation System shall fully integrate into the district wide Building Automation BACnet network. BACnet device IDs and IP reservation naming and addressing must be assigned and/or approved by OU's Building Systems Integration Manager (BSIM)
- B. The new control system for Lin Hall (Third and Fourth floor HVAC units) and to an existing DDC system currently in place which is to be fully maintained and not part of this controls contract. Add new panels, control boards, power supplies, relays, transducers, devices, wiring, sensors and output devices with new systems and equipment
- C. The required integration shall include the creation of custom graphics and the compilation and display of all devices and objects on one of the following virtual servers:
  - i Existing Delta Controls Operator Workstation (OWS) via Enteliweb software, or
  - ii Existing WebCTRL by Automated Logic Controls Operator Workstation and Web server, or
  - iii New Distech Operator Workstation (OWS) with EC-GFX extension of Niagara N4 Workstation software (latest version).
  - iv All graphic displays will reside on the existing or new workstation and be modified accordingly. In addition, the system shall perform the said integration through the use of BACnet/IP communications. BACnet over Ethernet will not be supported for district wide communications. Failure to mention any specific item or device does not relieve the

Contractor of the responsibility for installing or integrating such device/peripheral in order to comply with the intent of the Drawings or this Specification.

- D. The BAS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for a complete, fully functional and commissioned BAS meeting the specified sequence of operation.
- E. Controls installer shall be responsible for all electrical work associated with the BAS control system.
1. All wiring incidental to this temperature control system shall be provided by the BAS Installer.
  2. The term "Wiring" shall be construed to include furnishing of wire, conduit, miscellaneous materials and labor as required for mounting and connecting electrical control devices, and providing electrical interlocks between equipment.
  3. Division 26 work includes 120 volt, 20 amp circuits and circuit breakers from normal and/or emergency power terminated at junction boxes, only where indicated on the Electrical Drawings. Controls Contractor is responsible for additional line voltage power as required for control system.
  4. Provide all control transformers as required for control system.
  5. Conceal all wiring in occupied finished spaces.
- F. BAS Contractor shall integrate existing equipment with new control devices, program new sequences into the BAS, and provide BACnet IP connections to the local BAS controller.
1. New VAV terminal boxes
    - a. Provide new ASCs for each VAV terminal box to control space temperature and minimum airflow rates into spaces as shown on the plans and temperature control diagrams.
    - b. Provide CO2 based demand-controlled ventilation sequence for gallery spaces, including room sensors where shown on plans
    - c. Provide hot water reheat control valves and integrate with sequence on all new reheat coils
    - d. Provide new sensors as shown on plans and temperature control diagrams
    - e. Integrate new controls into front end operator interface with full graphics for each room by floor and each sub system.
  2. New Return Fans RF-5 and RF-6
    - a. Integrate new static pressure sensors/control points to new BAS
    - b. Control associated fan in sequence with air handlers AHU-5 and AHU-6 and through new VFDs
    - c. Integrate control sequences and graphics into new BAS front end

3. New air handling units AHU- and AHU-6
    - a. Provide new AHU unit controllers and devices for all points listed and shown on the temperature control diagrams in the drawings for AHU-5 and AHU-6.
    - b. Integrate with new VFD fan speed controllers.
    - c. Provide new graphics and integrate new control sequences into program.
  
  - G. BAS Contractor shall provide programming modifications necessary to fine tune sequences during commissioning and through the warranty period of system and for an additional 12 months, at no extra cost to Ohio University
  - H. Preparing Submittals and Shop Drawings for all hardware and software and submit within 30 days of the award of Contract.
  - I. Providing all stand-alone BAS panel hardware and related peripherals, including interconnecting cabling and power supply required.
  - J. Providing all field devices including remote input/output devices, sensors, transmitters, relays, contactors, transducers, and associated electronics required to effect all interfaces.
  - K. Providing all communications hardware necessary for implementing data links between the BAS panel(s) and all field devices.
  - L. Providing all specified software required to implement a complete and operational BAS, including verification and graphics of systems.
  - M. Furnishing complete Operating and Maintenance Manuals, and field training of operators and maintenance personnel.
  - N. Accomplishing all factory and field acceptance tests as indicated.
  - O. Graphics for operator workstations. Indicate via floor plans the location of mechanical and electrical equipment. The operator shall be viewing/controlling these systems via graphical displays.
  - P. System commissioning, checkout and Owner training.
- 1.2 APPROVED CONTROL SYSTEM MANUFACTURERS AND INSTALLERS
- A. Delta Controls installed by BCI  
  
Contact: Eric Male ([emale@bcicontrols.com](mailto:emale@bcicontrols.com)), 614-306-0227  
Secondary: Karl Suchy ([ksuchy@bcicontrols.com](mailto:ksuchy@bcicontrols.com))
  
  - B. Automated Logic installed by Premier Energy Systems  
  
Contact: Jerry Priddy ([jpriddy@premiermch.com](mailto:jpriddy@premiermch.com)), 304-741-7878  
Secondary: Raven Barker ([rbarker@premiermch.com](mailto:rbarker@premiermch.com))
  
  - C. Distech Controls by Geiger Brothers, Inc.  
  
Contact: Tanner Lawhun ([tlawhun@geigerbrothers.com](mailto:tlawhun@geigerbrothers.com)) 740-727-2826



Secondary: Josh Jenkins ([jjenkins@geigerbrothers.com](mailto:jjenkins@geigerbrothers.com) )

D. Distech Controls by Ameresco

Contact: Lucas Dixon ([ludixon@ameresco.com](mailto:ludixon@ameresco.com) ) 614-580-3352

Secondary: Jacob Smith ([jesmith@ameresco.com](mailto:jesmith@ameresco.com) ) 614-813-8252

1.3 INTEGRATION INTO EXISTING/NEW FRONT END REQUIREMENT SYSTEM:

A. The building automation system (BAS), utilizing BACnet protocol, shall integrate multiple building functions including:

1. Equipment supervision and control
2. Graphics
3. Scheduling
4. Alarms
5. Historical Data Collection (Trending)

B. The building automation system shall consist of the following:

1. Stand-alone peer-to-peer BACnet Building Controllers. (Ethernet connectivity is required for all Building Controllers.)
2. Provide seamless interconnection to the existing campus BACnet network, existing servers and graphics.
3. All trend logs, schedules and alarms, will be in accordance with BACnet protocols.
4. Software must be upgraded to latest available.
5. All energy and water meters shall be trended per OU standards in Niagara Tridium Meter database and interfaced seamlessly with the earthright dashboard.

C. Dynamic Color Graphic Displays

1. Color graphic floor plan displays and system schematics for each piece of mechanical equipment, including air handling units, exhaust fans, fan coil units, chilled and hot water systems, domestic cold water, and steam systems, room level terminal unit equipment shall be provided by the BAS contractor as indicated in the point I/O summary of this specification to optimize system performance analysis and speed alarm recognition. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection or text-based commands. Floor plans should show what fan coil or VAV terminal unit serves the area.
2. Dynamic temperature values, humidity values, flow values, percent load, and status indication shall be shown in their actual respective locations and shall automatically update to represent current conditions without operator intervention.

3. The windowing environment of the PC operator workstation shall allow the user to simultaneously view several graphics at a time to analyze total building operation or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.
4. The BAS contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components, complete mechanical systems, and electrical symbols.
5. The graphic package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
  6. Define symbols
  7. Position and size symbols
  8. Define background screens
  9. Define connecting lines and curves
  10. Locate, orient and size descriptive text
  11. Define and display colors for all elements
  12. Establish correlation between symbols or text and associated system points or other displays
  13. Ability to import scanned images and CAD drawings in Autodesk®, DWG format.
  14. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout or any other logical grouping of points that aids the operator in the analysis of the facility.
  15. To accomplish this, the user shall be able to build graphic displays that include point data from multiple controllers.
  16. Dynamic system status graphic of the site-specific architecture showing status of system hardware, including quantity and address of networks, field panels, terminal equipment controllers, and printers.
  17. The BAS contractor shall employ the use of accurate floor plans as part of the overall graphics package. The floor plans shall illustrate the location of room sensors and equipment and accurate room numbers. In addition, the floor plans shall utilize a thermograph scheme to instantly alert the end user of hot and cold areas. The thermograph shall illustrate and automatically intensify the red and blue gradient fills for each area, as to indicate the severity of the overheating or overcooling problem. 5°F above or below the set point.

D. Scheduling

1. Provide schedules adhering to the BACnet protocol and integrate into the existing central workstation and webserver per OU standards.

2. Provide a graphical spreadsheet-type format for simplification of time-of-day scheduling and overrides of building operations. Provide the following spreadsheet graphic types as a minimum:
    3. BACnet schedules
    4. BACnet calendars
    5. Weekly schedules shall be provided for each building zone or piece of equipment with a specific occupancy schedule. Each schedule shall include columns for each day of the week as well as holiday and special day columns for alternate scheduling on user-defined days. Equipment scheduling shall be accomplished by simply inserting occupancy and vacancy times into appropriate information blocks on the graphic. In addition, temporary overrides and associated times may be inserted into blocks for modified operating schedules. After overrides have been executed, the original schedule will automatically be restored.
    6. Zone schedules shall be provided for each building zone as previously described. Each schedule shall include all commandable points residing within the zone, unless custom programming is used to enable/disable the points. Each point may have a unique schedule of operation relative to the zone's occupancy schedule, allowing for sequential starting and control of equipment within the zone.
    7. Monthly calendars, until the year 2030, shall be provided which allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device and shall automatically reschedule equipment operation as previously defined on the weekly schedules.
- E. Alarms
1. Provide alarms adhering to the BACnet protocol and integrate into the existing central workstation and webserver.
  2. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each Building Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost.
  3. Alarms shall be prioritized to minimize nuisance reporting and to speed operator response to critical alarms.
  4. Alarm reports and messages will be directed to a user-defined list of operator devices or PCs. 5. In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 200 character alarm message to more fully describe the alarm condition or direct operator response.
- F. Collection and Analysis of Historical Data
1. Provide trend logs adhering to the BACnet protocol and integrate into the existing central workstation and webserver.
  2. Provide trending capabilities that allow the user to easily monitor and preserve records of system activity over an extended period of time. Trend data may be stored on hard disk for future diagnostics and reporting. In addition, the BAS system shall automatically trend and

archive all alarms and user activity (no exceptions). 3. Trend data report graphics shall be provided to allow the user to view all trended point data. The BAS system shall employ the use of Multiple Trend-Logs which may be customized to include up to 8 individual single trends in one viewable and printable format.

3. Provide additional functionality that allows the user to view trended data on trend graph displays. Displays shall be actual plots of both static and/or real-time dynamic point data. A maximum of 8 points may be viewed simultaneously on a single graph, with color selection and line type for each point being user-definable. Displays shall include an 'X' axis indicating elapsed time and a 'Y' axis indicating a range scale in engineering units for each point. The 'Y' axis shall have the ability to be manually or automatically scaled at the user's option. Different ranges for each point may be used with minimum and maximum values listed at the bottom and top of the 'Y' axis. All 'Y' axis data shall be color-coded to match the line color for the corresponding point. Capability for both Static and Dynamic Graphs.
- G. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, Building Controllers, expansion modules and operator devices.
- H. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection

#### 1.4 SUBMITTALS

- A. Refer to Section 23 01 00.
- B. Submit complete temperature control Shop Drawings, including control diagrams, sequence of operation and component specification data prior to installation or fabrication of any equipment. Submittal data shall include a schedule of all devices and materials to be installed, selected for optimum system operation; including location, schedules, properly sized control valves and dampers. Submittals shall also include all control devices, control panel and communication wiring diagrams.
- C. Deviations in details from the specified sequence of operation shall be clearly noted on the submittal.

#### 1.5 ITEMS FURNISHED BUT NOT INSTALLED

- A. Automatic control valves
- B. Automatic control dampers
- C. Variable Frequency Drives
- D. Immersion wells
- E. Pressure taps
- F. Flow Switches
- G. The above items will be installed in the piping provided by the HVAC Contractor with installation in wells and wiring of controls by the BAS contractor.

#### 1.6 QUALITY ASSURANCE

- A. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be manufacturer's latest standard design that complies with the specification requirements.
- B. Install system using competent workers who are fully trained and factory certified in the installation of temperature control equipment.
- C. The complete installation and proper operation of the Building Automation Controls System shall include debugging and calibration of each component in the entire system and shall be the single source responsibility of BAS Contractor.
- D. BAS Contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and all necessary test and diagnostic equipment.
- E. All BAS controllers shall be UL 916 Listed at the time of bid. All Network Controllers shall be BTL BBC certified.

#### 1.7 SERVICE AND GUARANTEE

- A. The BAS Supplier shall be fully responsible for the debugging, calibration, PID loop toning and proper operation of the Building Automation System, including but not limited to, sensors, controls, communication links, and peripheral devices.
- B. The BAS Supplier shall also be fully responsible for providing and loading the specified software packages, to include the loading of all necessary operational parameters. Any debugging of software shall be performed solely by the BAS Supplier.
- C. The BAS system shall be designed and installed, commissioned and serviced by factory trained personnel. BAS contractor shall have an in-place support facility within 100 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment. The BAS contractor shall provide an experienced project manager for this work, responsible for direct supervision of the design, installation, start up and commissioning of the BAS. The Bidder shall be regularly engaged in the installation and maintenance of BAS systems and shall have a minimum of ten (10) years of demonstrated technical expertise and experience in the installation and maintenance of BAS systems similar in size and complexity to this project.
- D. After completion of system installation adjust all new thermostats, control valves, motors and other equipment provided under this section with trained personnel. Place controls in operating condition subject to the approval of the Engineer. Instruct operating personnel in the operation and maintenance of the control system.
- E. Warrant labor and materials for specified control system free from defects for a period of 12 months after final acceptance. Failures on control systems that include all computer equipment, transmission equipment and all sensors and control devices, including actuators, during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.
- F. Work shall have a single warranty date, even if Owner receives beneficial use due to early system start-up. If specified work is split into multiple contracts or a multi-phase contract, each contract or phase shall have a separate warranty start date and period.
- G. Provide updates to operator workstation software, project-specific software, graphic software, database software, and firmware that resolve Contractor identified software deficiencies at no charge.

during warranty period. If available, Owner can purchase in-warranty service agreement to receive upgrades for functional enhancements associated with the above-mentioned items. Do not install updates or upgrades without Owner's written authorization. The BSIM can provide admin rights on server during the job.

H. Exception:

1. Contractor shall not be required to warrant reused devices, except those that have been rebuilt or repaired. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Engineer's acceptance.
2. Contractor shall not be required to warrant systems, equipment and devices or software if the damages and/or failures were caused by lack of training, unauthorized use, negligence or deliberate action of other parties, or job site conditions.

1.8 TRAINING

- A. Provide competent instructors to instruct Owner's designated personnel in the adjustment, operation and maintenance of the system installed. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach.
- B. All training shall be held during normal working hours, 8:00 a.m. to 4:30 p.m. weekdays or as requested by the Owner:
- C. Provide sixteen (16) hours on site/off-site training for Owner's operating personnel. Training shall include:
  1. Explanation of Drawings, Operations and Maintenance Manuals.
  2. Walk-thru of the job to locate control components.
  3. Direct Digital Controller and Application Specific Controller operation/function.
  4. Explanation of adjustment, calibration and replacement procedures.
  5. Review and use of schedules and setbacks.
  6. A final review with BSIM and control shop manager before final sign off as complete.

**PART 2 - PRODUCTS**

2.1 CONTROL SYSTEM ARCHITECTURE (DDC SYSTEM)

- A. The building automation system (BAS) shall integrate multiple functions of the building including equipment supervision and control, alarm management, energy management, historical data collection and lighting control.
- B. The building automation system shall consist of the following:
  1. Stand-alone DDC Controllers (BACnet ASHRAE 135 and BTL tested)
  2. Stand-alone Application Specific Controllers (ASC)

- C. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC Controllers, Application Specific Controllers and operator devices.
- D. System Architecture shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator I/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.
- E. DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central processing device. DDC Controllers shall also be able to send alarm reports to the workstation without dependence upon a central processing device.
- F. Materials and equipment shall be the catalogued products of manufacturers regularly engaged in production and installation of automatic temperature control systems and shall be the manufacturer's latest standard design that complies with the Specification requirements.
- G. Single source responsibility of the supplier shall be the complete installation of the Building Automation System and control system including debugging and proper calibration of each system component.
- H. All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Section 15, Governing Radio Frequency Electromagnetic Interference. I. All system components shall be fault-tolerant.
  - 1. Satisfactory operation within a range of 85 percent to 110 percent of rated voltage and at 3 Hertz variation in-line frequency without damage.
  - 2. Static, transient and short-circuit protection on all inputs and outputs.
  - 3. Protect communication lines against incorrect wiring, static transients and induced magnetic interference.
  - 4. Network-connected devices to be AC coupled or equivalent so that any single device failure will not disrupt or halt network communication.
  - 5. All real time clocks and data file RAM shall be battery-backed for a minimum 48-hours and include local and system low battery indication.
  - 6. System shall be capable of receiving and printing alarms at the central location even when the workstation at that location is non-operational or taken out of service for periodic maintenance.

## 2.2 NETWORKING COMMUNICATIONS (DDC SYSTEM)

- A. The design of the BAS shall network the operator workstation and stand-alone DDC Controllers. The network architecture shall consist of two levels, a high performance peer-to-peer network and DDC Controller specific local area networks.
- B. Access to system data shall not be restricted by the hardware configuration of the building automation system. The hardware configuration of the BAS network shall be totally transparent to the user when accessing data or developing control programs.
- C. Peer-to-Peer Network Level

1. The operator workstation and DDC Controllers shall directly reside on a network such that communications may be executed directly between DDC Controllers and between DDC Controllers and workstation on a peer-to-peer basis.
2. All operator devices either network resident or connected via dial-up modems shall have the ability to access all point status and application report data or execute control functions for any and all other devices via the peer-to-peer network. Access to data shall be based upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.
3. Network design shall include the following:
  - a. High-speed data transfer rates for alarm reporting, quick report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any DDC Controller is displayed at workstations and/or alarm printers within 5 seconds.
  - b. Support of any combination of DDC Controllers and the operator workstations directly connected to the peer-to-peer network. A minimum of 32 devices shall be supported on a single network.
  - c. Message and alarm buffering to prevent information from being lost.
  - d. Error detection, correction and retransmission to guarantee data integrity.
  - e. Synchronization of real-time clocks; include automatic daylight savings time updating between all DDC Controllers.

D. DDC Controller Local Area Network (LAN)

1. This level communication shall support a family of application specific controllers and shall communicate bi-directionally with the peer-to-peer network through DDC Controllers for transmission of global data.
2. Application specific controllers shall be arranged on the LAN(s) in a functional relationship manner with DDC Controllers. Each building or addition shall be on its own LAN.
3. Only one building control should serve as the BBMD and should be assigned and approved by the BSIM.

2.3 DDC CONTROLLER

- A. Stand-alone DDC Controllers shall be microprocessor-based with a minimum word size of 16 bits. They shall also be multi-tasking, multi-user, real-time digital control processors consisting of modular hardware with plug-in enclosed processors, communication controllers, power supplies and input/output point modules. Controller size shall be sufficient to fully meet the requirements of this Specification.
- B. Each DDC Controller shall have sufficient memory, a minimum of 1 megabyte, to support its own operating system and databases, including:
  1. Control processes
  2. Energy management applications



3. Alarm management applications including custom alarm messages for each level alarm for each point in the system.
4. Historical/trend data for points specified
5. Maintenance support applications
6. Custom processes
7. Operator I/O
8. Dial-up communications
9. Manual override monitoring
10. Ability to self-reset/restart after a power glitch. C. Each DDC Controller shall support:
  1. Monitoring of the following types of inputs, without the addition of equipment outside the DDC Controller cabinet:
    - a. Analog inputs
      - 1) 20 mA
      - 2) 0-10 Volts DC
      - 3) Thermistors
      - 4) 1000 ohm RTD's
    - b. Digital inputs
      - 1) Dry contact closure
      - 2) Pulse accumulator
      - 3) Voltage sensing
  - C. Direct control of electronic actuators and control devices. Each DDC Controller shall be capable of providing the following control outputs without the addition of equipment outside the DDC Controller cabinet.
    - a. Digital outputs (contact closure)
    - b. Analog outputs
      - 1) 0-10 Volts DC
  - D. Each DDC Controller shall have a minimum of 10 percent spare capacity for future point connection. The type of spares shall be in the same proportion as the implemented I/O functions of the panel, but in no case shall there be less than two spares of each implemented I/O type. Provide all processors, power supplies and communication controllers complete so that the implementation of a point only requires the addition of the appropriate point input/output termination module and wiring.
    1. Provide sufficient internal memory for the specified control sequences and have at least 25 percent of the memory available for future use.

2.4 DDC CONTROLLER RESIDENT SOFTWARE FEATURES

A. General

1. Provide all necessary software for a complete operating system.
2. The software programs shall be provided as an integral part of DDC Controllers and shall not be dependent upon any higher level computer for execution.

B. Control Software Description

1. The DDC Controller shall have the ability to perform the following pre-tested control algorithms:
  - a. Two-position control
  - b. Proportional control
  - c. Proportional plus integral control
  - d. Proportional, integral, plus derivative control
2. Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
3. The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical load.
4. Upon the resumption of normal power, each DDC Controller shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling and turn equipment on or off as necessary to resume normal operations.

C. DDC Controllers shall have the ability to perform any or all of the following energy management routines:

1. Time-of-day scheduling
2. Calendar-based scheduling
3. Holiday scheduling
4. Temporary schedule overrides
5. Start-stop time optimization
6. Automatic daylight savings time switchover
7. Night setback control
8. Temperature-compensated duty cycling
9. Fan speed
10. Heating/cooling interlock
11. Dial-up communications

12. All programs shall be executed automatically without the need for operator intervention and shall allow user customization.
- D. DDC Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.
1. It shall be possible to use any of the following in a custom process:
    - a. Any system measured point data or status
    - b. Any calculated data
    - c. Any results from other processes
    - d. User-defined constants
    - e. Arithmetic functions (addition, subtraction, multiplication, division, square root, exp, etc.)
    - f. Boolean logic operators (and/or, exclusive or, etc.)
    - g. On-delay/off-delay/one-shot timers
  2. Custom processes may be triggered based on any combination of the following:
    - a. Time interval
    - b. Time-of-day
    - c. Date
    - d. Other processes
    - e. Time programming
    - f. Events (e.g., point alarms)
  3. A single process shall be able to incorporate measured or calculated data from any and all other DDC Controllers on the network. In addition, a single process shall be able to issue commands to points in any and all other DDC Controllers on the network.
  4. Processes shall be able to generate operator messages and advisories to operator I/O devices.

A process shall be able to directly send a message to a specified device or cause the execution of a dial-up connection to a remote device such as printer or pager.
  5. The custom control programming feature shall be documented via English language descriptors.
- E. Alarm management shall be provided to monitor and direct alarm information to operator devices. Each DDC Controller shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic and prevent alarms from being lost. At no time shall the DDC Controllers ability to report alarms be affected by either operator or activity at a workstation, local I/O device or communications with other panels on the network.

1. All alarm or point change reports shall include the point's English language description and the time and date of occurrence.
  2. Alarm reports and messages will be directed to a user-defined list of operator devices.
  3. In dial-up applications, operator-selected alarms shall initiate a call to a remote operator device.
- F. A variety of historical data collection utilities shall be provided to manually or automatically sample, store and display system data for points as specified.
1. DDC Controllers shall store point history data for selected analog and digital inputs and outputs.
- G. DDC Controllers shall automatically accumulate and store run-time hours for digital input and output points as specified in the point I/O summary.
1. The totalization routine shall have a sampling resolution of one minute or less.
  2. The user shall have the ability to define a warning limit for run-time totalization. Unique, user-specified messages shall be generated when the limit is reached.
- H. DDC Controllers shall have the ability to count events such as the number of times a system is cycled on and off. Event totalization shall be performed on a daily, weekly or monthly basis for points as specified in the point I/O summary.
1. The event totalization feature shall be able to store the records associated with a minimum of 9,999.9 events before reset.
  2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

## 2.5 APPLICATION SPECIFIC CONTROLLERS (ASC)

### A. General

1. Each DDC Controller shall be able to extend its performance and capacity through the use of remote application specific controllers (ASC).
2. Each ASC shall operate as a stand-alone controller capable of performing its specified control responsibilities independently of other controllers in the network. Each ASC shall be a microprocessor-based, multi-tasking, real-time digital control processor.
3. Each ASC shall have sufficient memory to support its own operating system and data bases including:
  - a. Control Processes
  - b. Energy Management Applications
  - c. Operator I/O (Portable Service Terminal)
4. The operator interface to any ASC point data or programs shall be through the network PC workstation, or a PC or portable operator's terminal connected to any panel in the network.

5. Application Specific Controllers shall directly support the temporary use of a portable service terminal. The capabilities of the portable service terminal shall include but not be limited to the following:
  - a. Display temperatures
  - b. Display status
  - c. Display setpoints
  - d. Display control parameters
  - e. Override binary output control
  - f. Override analog setpoints
  - g. Modification of gain and offset constants
6. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the controller.
7. Configuration and Download: The ASC shall have the capability of receiving configuration and program loading by all of the following:
  - a. Locally, via a direct connect portable laptop service tool.
  - b. Over the network, from the portable laptop service tool.
  - c. From an Operator Workstation, via the communication network.
8. Hardware Override Switches: The operators shall have the ability to manually override automatic or centrally executed commands at the network panel via local, point discrete, onboard hand/off/auto operator override switches for binary control points and gradual switches for analog control type points. These override switches shall be operable whether the panel is powered or not.
9. Hardware Override Monitoring: Network panels shall monitor the status or position of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited. Network panels shall also collect override activity information for daily and monthly reports.
10. Local Status Indicator Lamps: The network panel shall provide local status indication for each binary input and output for constant, up-to-date verification of all point conditions without the need for an operator I/O device.

B. Unitary Controllers

1. Unitary Controllers shall support, but not be limited to, the following types of systems:
  - a. Fan Coil Unit
2. Unitary Controllers shall support the following types of point inputs and outputs:
  - a. Heating and Cooling Outputs

- 1) Analog Output with four-pipe logic
- b. Fan Output
- 1) Variable air volume logic
3. Unitary controllers shall support the following library of control strategies:
  - a. Daily/Weekly Schedules
  - b. Comfort/Occupancy Mode
  - c. Economy Mode
    - 1) Unoccupied
    - 2) Shutdown
  - d. Temporary Override Mode
    - 1) Temporary Comfort Mode (Occupancy-Based Control)
    - 2) Boost (Occupant Warmer/Cooler Control)
4. Continuous Zone Temperature Histories: Each Unitary Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.
5. Alarm Management: Each Unitary Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.

## 2.6 OPERATOR INTERFACE SOFTWARE

- A. Basic Interface Description 1. Operator Workstation interface software shall minimize operator training through the use of English language prompting, English language point identification, and industry standard PC application software. The operator interface shall minimize the use of a typewriter-style keyboard through the use of a mouse and with finger touch screen interface to provide a "point and click" approach to menu selection. The system operator shall perform all person machine interface functions (ie., start/stop, setpoints) by use of the mouse and by finger touch on monitor screen. Touch devices which overlay on monitor screen are not acceptable.
- B. The operator workstation software shall be based on Microsoft Windows. The operator shall have the ability to incorporate industry-standard Microsoft Windows Dynamic Data Exchange Interface (DDE) for client applications using any third-party software package (Microsoft compatible).
- C. The BAS graphic software package shall allow the Owner to import AutoCAD files of floor plans for display.
- D. At the option of the user, Operator Workstations shall provide consistent graphical or text- based displays of all system point and application data described in this Specification. Point identification, Engineering units, status indication and application naming conventions shall be the same at all workstations.

- E. The Operator Interface shall provide the ability to simultaneously view several different types of system displays in overlapping windows to speed building analysis. For example, the interface shall provide the ability to simultaneously display a graphic depicting an air handling unit, while displaying the trend graph of several associated space temperatures to allow the user to analyze system performance.
- F. Multiple-level password access protection shall be provided to limit workstation control, display and database manipulation capabilities as deemed appropriate for each user, based upon an assigned password.
1. Passwords shall be exactly the same for all operator devices, including portable or panel-mounted network terminals.
  2. Any additions or changes made to password definition shall automatically cause passwords at all network panels on a network to be updated and downloaded to minimize the task of maintaining system security.
  3. A minimum of five levels of access shall be supported:
    - a. Level 1 = Data Access and Display
    - b. Level 2 = Level 1 plus Operator Overrides
    - c. Level 3 = Level 2 plus Database Modification
    - d. Level 4 = Level 3 plus Database Generation
    - e. Level 5 = Level 4 plus Password Add/Modification
  4. A minimum of 50 passwords shall be supported at each network panel.
  5. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device, including portable or panel mounted devices, shall be limited to only those items defined for the access level of the password used to log-on.
  6. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices on-line.
- G. The operator interface shall allow the operator to perform commands including, but not limited to, the following:
1. Start-up or shutdown selected equipment
  2. Adjust setpoints
  3. Add/Modify/Delete time programming
  4. Enable/Disable process execution
  5. Lock/Unlock alarm reporting for each point
  6. Enable/Disable Totalization for each point
  7. Enable/Disable Trending for each point
  8. Override PID loop setpoints

9. Enter temporary override schedules
  10. Define Holiday schedules
  11. Change time/date
  12. Enter/Modify analog alarm limits
  13. Enter/Modify analog warning limits
  14. View limits
  15. Enable/Disable Demand Limiting for each meter
  16. Enable/Disable Duty Cycle for each load
- H. Reports shall be generated automatically or manually, and directed to either CRT displays, printers, or disk files. As a minimum, the system shall allow the user to easily obtain the following types of reports:
1. A general listing of all points in the network
  2. List all points currently in alarm
  3. List of all off-line points
  4. List all points currently in override status
  5. List of all disabled points
  6. List all points currently locked out
  7. List of all items defined in a "follow-up" file
  8. List all Weekly schedules
  9. List all Holiday programming
  10. List of limits and deadbands
- I. Summaries shall be provided for specific points, for a logical point group, for a user- selected group of groups, or for the entire facility without restriction due to the hardware configuration of the facility management system. Under no conditions shall the operator need to specify the address of hardware controller to obtain system information.
- J. Provide Color graphic floor plan displays, and system schematics for mechanical equipment.
1. The operator interface shall allow users to access the various system schematics and floor plans via a graphical penetration scheme, menu selection, or text-based commands.
  2. Dynamic temperature values, humidity values, flow values, and status indication shall be shown in their actual respective locations, and shall automatically update to represent current conditions without operator intervention.
  3. The windowing environment of the PC Operator Workstation shall allow the user to simultaneously view several graphics at the same time to analyze total building operation,



or to allow the display of a graphic associated with an alarm to be viewed without interrupting work in progress.

4. Graphic generation software shall be provided to allow the user to add, modify, or delete system graphic displays.
  - a. The BAS Contractor shall provide libraries of pre-engineered screens and symbols depicting standard air handling unit components i.e., fans, cooling coils, filters, dampers, etc., complete mechanical systems i.e., heat pump, condenser water, etc. and electrical symbols similar to those indicated on the drawings.
  - b. The graphic development package shall use a mouse or similar pointing device in conjunction with a drawing program to allow the user to perform the following:
    - 1) Define symbols
    - 2) Position and size symbols
    - 3) Define background screens
    - 4) Define connecting lines and curves
    - 5) Locate, orient and size descriptive text
    - 6) Define and display colors for all elements
    - 7) Establish correlation between symbols or text and associated system points or other displays
  - c. Graphical displays can be created to represent any logical grouping of system points or calculated data based upon building function, mechanical system, building layout, or any other logical grouping of points which aids the operator in the analysis of the facility. To accomplish this, the user shall be able to build displays that include point data from multiple network panels, including application specific controllers used for DDC unitary control.
  - d. Graphics must be able to be modified and changed by owner in the future.
- C. All temperature and equipment control strategies and energy management routines shall be definable by the operator. System definition and modification procedures shall not interfere with normal system operation and control.
  1. The system shall be provided complete with all equipment and documentation necessary to allow an operator to independently perform the following functions:
    - a. Add/Delete/Modify Stand-alone network panels
    - b. Add/Delete/Modify Operator Workstations
    - c. Add/Delete/Modify Application Specific Controllers
    - d. Add/Delete/Modify points of any type, and all associated point parameters, and tuning constants
    - e. Add/Delete/Modify alarm reporting definition for each point
    - f. Add/Delete/Modify control loops

- g. Add/Delete/Modify energy management applications
  - h. Add/Delete/Modify time and calendar-based programming
  - i. Add/Delete/Modify Totalization for every point
  - j. Add/Delete/Modify Historical Data Trending for every point
  - k. Add/Delete/Modify custom control processes
  - l. Add/Delete/Modify any and all graphic displays, symbols, and cross-references to point data
  - m. Add/Delete/Modify dial-up telecommunication definition
  - n. Add/Delete/Modify all operator passwords
  - o. Add/Delete/Modify Alarm Messages
2. Definition of operator device characteristics, network panels, individual points, applications and control sequences shall be performed through fill-in-the-blank templates and graphical programming approach.

Graphical programming shall allow the user to define the software configuration of DDC control logic for HVAC system control sequences, fan interlocks, PID control loops, and other control relationships through the creation of graphical logic flow diagrams.

- a. Graphical Programming: Control sequences are created by using a mouse input device to draw interconnecting lines between symbols depicting inputs, operators (comparisons and mathematical calculations), and outputs of a control sequence. As a minimum, graphic symbols shall be used to represent:
  - 1) Process inputs, such as temperature, humidity, or pressure values, status, time, date, or any other measured or calculated system data
  - 2) Mathematical Process Operators, such as addition, subtraction, multiplication, or greater than, equal to, less than, etc.
  - 3) Logical Process Operators such as AND, OR, Exclusive OR, NOT, etc.
  - 4) Time delays
  - 5) Process Control Outputs such as start/stop control points, analog adjust points, etc.
  - 6) Process Calculation Outputs
  - 7) Text file Outputs and Advisories
- b. Network-Wide Strategy Development: Inputs and outputs for any process shall not be restricted to a single network panel, but shall be able to include data from any and all other network panels to allow the development of network-wide control strategies. Processes shall also allow the operator to use the results of one process as the input to any number of other processes (cascading).
- c. Sequence Testing and Simulation: A software tool shall be provided, which allows a user to simulate control sequence execution to test strategies before they

are actually applied to mechanical systems. Users shall be able to enter hypothetical input data, and verify desired control response and calculation results via graphical displays and hardcopy printouts.

3. All portions of system definition shall be self-documenting to provide hardcopy printouts of all configuration and application data. Control process and DDC control loop documentation shall be provided in logical, graphical flow diagram format to allow control sequences to be easily interpreted and modified at any time in the future.
4. Back-up copies of all stand-alone network panel databases shall be stored in the personal computer operator workstation. Continuous supervision of the integrity of all network panel data bases shall be provided. In the event that any network panel on the network experiences a loss of its database for any reason, the system shall automatically download a new copy of the respective database to restore proper operation. Data base back-up/download shall occur over the local area network without operator intervention. Users shall also have the ability to manually execute downloads of any or all portions of a network panels database.

## 2.7 CONTROL SYSTEM COMPONENTS (GENERAL)

- A. Control Valves: Single-seated, two-way straight through body type or three-way mixing or diverting body, polished stainless steel stems, and spring loaded teflon packing.
  1. Valves shall have a modulating plug for steam or water service depending upon its particular use. Where required valves shall be spring sequenced to give proper operation of control and the operator shall be of sufficient size and power to give positive shutoff or gradual modulation as required.
  2. Water valves shall be sized on the basis of 15 percent of the total system pressure drop, but not more than 10 feet of head drop. Size 3-way hot water zone valves for not more than 5 feet of head drop. Steam valves shall be of size to provide a maximum pressure drop of system inlet, minus equipment design or 5 psi whichever is less.
  3. Valves 2 inches and smaller: screwed bodies; 2-1/2 inches and larger: flanged bodies; designed for 125 psi operating pressure. Arranged to fail-safe as called for, tight closing and quiet operating.
  4. Physical sizes of valves will be such that they will fit within the physical space provided within radiation and equipment enclosures. Verify before ordering materials.
  5. The controls supplier shall correctly size all valves and supervise their installation. Submit valve sizing as part of shop drawing submittal.
- B. Electric Operators (Valve): Provide 24 Volts AC valve actuators which are 0-10 Volt DC input proportional or two position with spring return as required by control sequence, designed for water or steam service valve bodies.

Operator shall be synchronous motor driven with up to 150 inch-pound force with force sensor safety stop. Enclosure shall be cast aluminum.
- C. Electric Operators (Damper): Provide 24 Volts (or voltage indicated on drawings) AC damper actuators which are 0-10 Volt DC input proportional or two position with spring return as required by control sequence, designed to operate control dampers. Operator shall be synchronous motor driven with up to 150 inch-pound force with force sensor safety stop and spring return as required. Enclosure shall be cast aluminum.

D. Air Flow Control Dampers

1. Provide low leakage air flow control dampers of size indicated on plans. Dampers shall be opposed or parallel blade operation to suit application.
2. The damper leakage rate at 4.0 inches w.g. pressure differential shall not be greater than 4.2 cfm per sq. ft.
3. Control dampers shall meet the following minimum construction standards. Frame shall be 16 gage galvanized steel structural hat channel with tabbed corners for reinforcement for 11 gage structural equivalence. Blades shall be 14 gage equivalent thickness galvanized steel, roll-formed airfoil type. Blade edge seals shall be neoprene type or equivalent suitable for - 72 degrees F to +275 degrees F, mechanically locked into the blade edge. Jamb seals shall be flexible metal, compression type to prevent leakage between blade end and damper frame.
4. No individual section of a damper shall be larger than 48 inch by 48 inch size. Dampers larger than 48 inch by 48 inch shall be made up of multiple damper sections. Provide jack shafts between multiple sections for connection to damper operator(s).
5. Bearings shall be corrosion resistant, permanently lubricated stainless steel sleeve type turning in an extruded hole in the damper frame. Axles shall be constructed of plated steel and be square or hexagonal positively locked into the damper blade. Linkage shall be concealed out of the airstream, within the damper frame.
6. Submittal shall include leakage, maximum air flow and maximum pressure ratings based on AMCA Publication 500.
7. Dampers shall be in all respects equivalent to Ruskin model CD60. Acceptable manufacturers are Ruskin and American Warming.

E. Local Control Panels

1. Provide for each control system a control panel suitable for wall mounting. Locate panel adjacent to systems served. All controllers, transducers, and associated control components shall be mounted in control panels.
2. Fabricate panels of 14 gauge furniture steel or aluminum totally enclosed on all sides with hinged door and key lock. Shop paint with manufacturer's standard color. Panel shall carry a NEMA rating suitable for installed location. Cabinets shall be grounded per Division 16 requirements.
3. Flush mount on the hinged door all manual switches: such as; damper positioning switches, summer/winter switches, plus all dial thermometers and/or indicating receiver gauges.
4. Provide proper cooling of cabinets to prevent inside temperature from exceeding component maximum operating temperature limits.

F. Control Transformers

1. 120 to 24 Vac with circuit breaker type overcurrent protection and foot and dual threaded hub mounted.
2. Transformer size shall be as required by control system.

2.8 DDC SYSTEM SENSORS

A. Temperature Sensors

1. Temperature sensors shall be 1,000 OHM RTD or 3,000 OHM type or thermistors with 0.36 degrees F accuracy. Analog temperature sensors shall provide an output signal that varies continuously with the sensed temperature, within a specified range.
2. All sensors of a particular category shall be of the same type and manufacturer. Provide temperature sensors suitable for one or more of the following mounting methods:
  - a. Immersion Type - suitable for immersion into fluids in tanks or pipes with separable well and heat transfer compound.
  - b. Outside Air Sensing Type - shall have sun shades to minimize solar effects and shall be mounted to minimize building outside air film effects.
  - c. Space Type - provide plastic vented, lockable guard enclosure where indicated on plans.
3. The following shall apply to temperature sensors:
  - a. All external trim material shall be completely corrosion resistant with all parts assembled into a watertight, vibration-proof, heat resistant assembly.
  - b. Sensor wells shall be brass and compatible with the sensor.

B. Differential Pressure Switches (Water)

1. All pressure sensing elements shall be corrosion resistant.
2. Pressure sensing elements shall be diaphragm type as required by the application.
3. Units shall have adjustable range and differential pressure settings.
4. Pressure sensor switches shall be snap action type.
5. Sensor assembly shall operate automatically and reset automatically when conditions return to normal.
6. Protect complete sensor assembly against vibration at all critical movement pivots and slides.
7. Sensors on all liquid lines shall have an isolation valve installed between each sensor and its pressure source.
8. Sensor Ratings: Sensors shall have the following pressure and accuracy ratings.
  - a. Water pressure sensors shall be rated at 125 psig, with an accuracy of plus or minus 1 psi.

C. Current Switch

1. Current switch shall be solid state self-powered and designed to sense AC current in a conductor passed through its circular window opening and provide an ON/OFF status indication of the powered equipment.

**PART 3 - EXECUTION**

### 3.1 GENERAL REQUIREMENTS

#### A. General

1. Install equipment, piping, and wiring/raceway parallel to building lines (i.e., horizontal, vertical, and parallel to walls) wherever possible.
2. Install all equipment in readily accessible locations as defined by the National Electrical Code (NEC).
3. Verify integrity of all wiring to ensure continuity and freedom from shorts and grounds.
4. All equipment, installation, and wiring shall comply with acceptable industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
5. As soon as the systems are operable, all controls, sensors and switches shall be properly calibrated.
6. Furnish and mount all relays, switches, pressure switches, extra contacts, as required in enclosures.
7. Each instrument shall be tagged by the use of embossed tape, corresponding to the symbol used on the control diagrams. Each Control panel and controller shall be identified by engraved nameplate.
8. Provide all line voltage temperature control devices. Wherever such devices are shown on electrical drawings, they shall be wired by Division 26; when not indicated on electrical drawings, they shall be wired by controls installer.
9. Provide all temperature control devices and all transformers required for the systems.
10. Motor operated dampers and valves furnished under this Section shall be installed under the applicable Section of Division 23 specification.
  - a. This controls supplier shall supervise, and shall be held fully responsible for proper installation and operation of these devices.
  - b. Whenever the installation of the dampers and valves is incorrect, controls supplier shall arrange for necessary corrections.
11. All controllers shall be provided with necessary contacts and devices for remote control point adjustment.
12. Provide dial thermometers at all duct and pipe sensors. Locate thermometer adjacent to sensor.
13. All equipment isolated for vibration shall have all electrical connections made within flex conduit.
14. Provide all initial schedules and setpoints per the Owner's direction. All setpoints and schedules shall be adjustable.
15. All room names and numbers in the BAS interface shall be adjustable and shall be updated to match the final room names and numbers of the project.

16. Thermostats used to control both heating and cooling shall be capable of providing a temperature range or dead band of 5°F minimum which the supply of heating and cooling energy to the zone is shut off or reduced to a minimum.
17. No devices are allowed to be mounted on the inside panels of the control box.
18. Control panel should include controller diagram and sequence on inside door.

### 3.2 WIRING:

- A. All control and interlock wiring shall comply with national and local electrical codes and Divisions 26 of this specification.
- B. All NEC Class 1 (line voltage) wiring shall be UL Listed in approved conduit according to NEC and Divisions 26 requirements.
- C. All low-voltage wiring shall meet NEC Class 2 requirements. (Low-voltage power circuits shall be sub fused when required to meet Class 2 current limit.)
- D. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in conduit may be used provided that cables are UL Listed for the intended application. For example, cables used in ceiling plenums shall be UL Listed specifically for that purpose.
- E. All wiring in mechanical, electrical, or service rooms—or where subject to mechanical damage—shall be installed in conduit.
- F. Do not install Class 2 wiring in conduit containing Class 1 wiring. Boxes and panels containing high voltage wiring and equipment may not be used for low-voltage wiring except for the purpose of interfacing the two (e.g., relays and transformers).
- G. Do not install wiring in conduit containing tubing.
- G. Where plenum rated cable is run exposed, wiring is to be run parallel along a surface or perpendicular to it and neatly tied at 10 ft intervals.
- H. Where plenum rated cable is used without conduit, it shall be supported from or anchored to structural members. Cables shall not be supported by or anchored to ductwork, electrical conduits, piping, or ceiling suspension systems.
- I. All wire-to-device connections shall be made at a terminal block or wire nut. All wire-to-wire connections shall be at a terminal strip or wire nut.
- J. All wiring within enclosures shall be neatly bundled and anchored to permit access and prevent restriction to devices and terminals.
- K. Maximum allowable voltage for control wiring shall be 120 V. If only higher voltages are available, the contractor shall provide step-down transformers or interposing relays.
- L. All plenum rated wiring shall be installed as continuous lengths, with no splices permitted between termination points
- M. All wiring in conduit shall be installed as continuous lengths, with no splices permitted between termination points or junction boxes.
- N. Maintain fire rating at all penetrations. Install plenum wiring in sleeves where it passes through walls and floors.

- O. Size and type of conduit and size and type of wire shall be the responsibility of the contractor, in keeping with the manufacturer's recommendations and NEC requirements, except as noted elsewhere.
- P. Conceal all conduit, except within mechanical, electrical, or service rooms. Install conduit to maintain a minimum clearance of 6 in. from high-temperature equipment (e.g., steam pipes or flues).
- Q. Secure conduit with conduit clamps fastened to the structure and spaced according to code requirements. Conduit and pull boxes may not be hung on flexible duct strap or tie rods. Conduits may not be run on or attached to ductwork.
- R. Adhere to this specification's Divisions 26 requirements where conduit crosses building expansion joints.
- S. The Contractor shall terminate all control and/or interlock wiring and shall maintain updated (as-built) wiring diagrams with terminations identified at the job site.
- T. Flexible metal conduits and liquid-tight, flexible metal conduits shall not exceed 3 ft in length and shall be supported at each end. Flexible metal conduit less than ½ in. electrical trade size shall not be used. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal conduits shall be used.
- U. Conduit must be adequately supported, properly reamed at both ends, and left clean and free of obstructions. Conduit sections shall be joined with couplings (according to code). Terminations must be made with fittings at boxes, and ends not terminating in boxes shall have bushings installed.

### 3.3 COMMUNICATION WIRING:

- A. All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.
- B. Do not install communication wiring in raceway and enclosures containing Class 1 or other Class 2 wiring.
- C. Maximum pulling, tension, and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.
- D. Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.
- E. When a cable enters or exits a building, a lightning arrestor shall be installed between the lines and ground. The lightning arrestor shall be installed according to the manufacturer's instructions.
- F. All runs of communication wiring shall be unspliced length when that length is commercially available.
- G. All communication wiring shall be labeled to indicate origination and destination data.

### 3.4 INSTALLATION OF SENSORS AND PANELS: A. General:

- 1. Install sensors in accordance with the manufacturer's recommendations.
- 2. Mount sensors rigidly and adequately for the environment within which the sensor operates.



3. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Locations on drawings are diagrammatic and may be changed with the approval of the Engineer.
4. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
5. Sensors used in mixing plenums and hot and cold decks shall be of the averaging type.
6. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across the full face of the coil.
7. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
8. Install outdoor air temperature sensors on north wall, complete with sun shield at designated location.
9. Control Panel locations shall be as indicated on plans or for the convenience of adjustment and service. Location shall be approved by Architect prior to installation.

### 3.5 ACTUATORS:

#### A. Electric/Electronic

1. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5° available for tightening the damper seals. Actuators shall be mounted following manufacturer's recommendations.
2. Valves: Actuators shall be connected to valves with adapters approved by the actuator manufacturer. Actuators and adapters shall be mounted following the actuator manufacturer's recommendations.
3. Actuators shall be labelled/marked for open and closed position. It should be marked NO (normally open) or NC (normally closed).

### 3.6 TESTING AND DEMONSTRATION

#### A. General

1. Whenever seasonal operating portions of the system occur at a time when final control settings and adjustments cannot be properly made due to outside weather conditions (cooling or heating), such final retesting and rebalancing as required shall be made during the first full load operating conditions of the respective seasons.
2. Demonstration: Upon complete installation and testing of the system, the controls installer shall demonstrate to the satisfaction of the Engineer that all requirements of the installation have been fulfilled as specified.

#### B. Testing and Balancing

1. The installation, programming, establishment of initial setpoints and debugging of all control systems is the responsibility of the controls supplier. The testing and balancing of the entire HVAC system including the temperature control system is the responsibility of the balancing agency.

2. During the testing and balancing phase of work, the controls supplier shall provide a technician to assist the balancing agency in the operation of the control system to establish the mode of operation required to properly test and balance the HVAC system and test and verify temperature control system operation.
3. Programming or setpoint changes required as a result of system analysis and balancing shall be made by the controls supplier.
4. Acceptance of tests by the Architect/Engineer shall not relieve controls supplier of any responsibility for the complete system meeting the requirements of these Specifications after installation.

3.7 POINTS LISTS I/O

- A. Refer to drawings for system I/O points lists

3.8 SEQUENCES OF OPERATION

- A. Refer to drawings for controls diagrams and Sequences of Operation for the following systems:
  1. Chilled Water Coils
  2. Heating Hot Water Coils
  3. Return Air Fans
  4. Air Handling Units and Control dampers (with demand-controlled ventilation)
  5. VAV Boxes and Reheat Coils (with demand-controlled ventilation)
  6. Unit Heaters

**END OF SECTION**

**ELECTRICAL SPECIFICATIONS - INDEX**

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## SECTION 26 00 10 - GENERAL PROVISIONS

### PART 1 - GENERAL

#### 1.01 CONTRACT DRAWINGS

- A. The Drawings accompanying these Specifications are complementary each to the other and what is called for by one shall be as if called for by both.
- B. Consult all Contract Drawings that may affect the location of equipment, conduit and wiring and make minor adjustments in location to secure coordination.
- C. Wiring layout is schematic and exact locations shall be determined by structural and other conditions. This does not mean that the design of the system may be changed. It refers only to the exact locations of conduit and equipment to fit into the building as constructed and with the coordination of conduit and other equipment with piping and equipment included under other divisions of the Specifications.
- D. Coordinate layout of Electrical work with other trades. Make minor adjustments in location required for coordination. Locations of structural systems, heating work and plumbing lines shall take preference over locations of conduit lines where conflict occurs.
- E. Other than minor adjustments shall be submitted to the A/E for approval before proceeding with the work.
- F. The location of outlets and switches shown on the Drawings is approximate, and the A/E shall have the right to relocate any outlets or switches before they are installed without additional cost.
- G. The first manufacturer listed in these Specifications or on the drawings, in schedule or coded note form, is the basis for design. Any manufacturers listed below this base manufacturer are considered to be other acceptable manufacturers. It shall be the responsibility of the Contractor and the Supplier to coordinate these other acceptable manufacturers' equipment with all building trades and building architecture. The other acceptable manufacturers' products shall match the base manufacturer's products in size, quality and performance.
- H. See General Conditions for additional coordination drawing requirements.

#### 1.02 MANUFACTURER'S DRAWINGS

- A. Submit to the A/E for review, within six weeks after date of contract, electronic files containing manufacturer's drawings, catalog data, and wiring diagrams. The A/E will review shop drawings and related submittals, as indicated below, with respect to the ability of the detailed work, when complete, to be a properly functioning integral element of the overall system designed by the A/E. Before submitting a shop drawing or any related material to the A/E, Contractor shall: review each such submission for conformance with the means, methods, techniques, sequences, operations of construction, safety precautions, and programs, all of which are the sole responsibility of Contractor. Contractor shall approve each such submission by stamping each submittal before submitting it. The A/E shall assume that no shop drawing or related submittal comprises a variation unless Contractor advises the A/E otherwise. The items, types of submittals and related material are indicated below:

ITEMS

TYPE SUBMITTALS REQUIRED

Low Voltage Wire and Cables	Catalog Cuts
Grounding	Catalog Cuts
Conduits	Catalog Cuts
Boxes and Plates	Catalog Cuts
Wiring Devices	Catalog Cuts
Enclosed Switches & Circuit Breakers	Catalog Cuts
Fuses	Catalog Data
Panelboards	Shop Drawings
Fire Alarm System	Shop Drawings

- B. The A/E shall return shop drawings and related materials with comments provided that each submission has been called for and is stamped by Contractor as indicated above. The A/E shall return, without comment, material not called for or which Contractor has not approved.
- C. A/E's review of Manufacturer's Drawings or Schedules shall not relieve the Contractor from responsibility for errors or omissions in Manufacturer's Drawings or Schedules and deviation from A/E's Drawings or Specifications.
- D. At the completion of the Job before final payment is made, the Contractor shall submit six (6) copies of Manufacturer's "As-Built" Drawings. Included with the Drawings shall be The Operating and Maintenance Manuals as called for in Section 26 01 20.
- E. Refer to the applicable Division 1 and General Conditions, including "Action Submittals".

### **1.03 JOB-SITE COPY OF DOCUMENTS**

- A. Maintain at the site, one copy of all Drawings, Specifications, Addenda, approved Shop Drawings, Change Orders and other modifications, in good order. The Drawings shall be marked to record all changes made during construction, especially deviations made necessary to incorporate equipment different from base equipment specified. These shall be available to the A/E. The Drawings shall be marked to record all changes made during construction and shall be delivered to the A/E for the University upon completion of the work. The A/E will furnish an additional set of Drawings for this purpose upon request.
- B. The Contractor shall keep an accurate record of all deviations from Contract Drawings and Specifications as required by the General Conditions.
- C. Submit As-Built documents as required by General Conditions

## **PART 2 PRODUCTS**

### **2.01 MATERIALS**

- A. All materials shall be new and undeteriorated and of a quality not less than the minimum specified.
- B. Materials and equipment for which there are Underwriters' Laboratories (UL) Standard requirements, listing and labels shall have listing of Underwriters' Laboratories and be so labeled.

### **2.02 SUBSTITUTIONS**

- A. See Instructions to Bidders, "Substitutions Prior to Bid Opening" for instructions on submitting substitutions and equivalent products.

**2.03 GUARANTEES**

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year and as required by the General Conditions.
- B. Product guarantees greater than one (1) year shall be passed along to the University for full benefit of the manufacturer's warranty.

**2.04 QUANTITIES**

- A. Items may be referred to as singular or plural on the Drawings and in the Specifications. The Contractor is responsible for determining quantity of each item required.

**PART 3 EXECUTION**

**3.01 INSTALLATION**

- A. Furnish and install all necessary hangers, supports, straps, boxes, fittings and other similar appurtenances not indicated on the Drawings but which are required for a complete, code-compliant, and operational system consistent with the Architectural treatment of the building.
- B. Review and become informed regarding peculiarities and limitations of space available for installation of materials and apparatuses under this contract, and see that all equipment necessary to be reached from time to time for operation and maintenance are made easily accessible. Clearances, when possible, shall be greater than those required by Code.
- C. At least 6'-6" clear headroom must be maintained in front of all electrical equipment. Provide clear work space in front of electrical equipment as follows:

<u>Equipment Voltage</u>	<u>Clear Space</u>
208/120 Volt	3'-0"
480/277 Volt	6'-0"

The same clear work space is required at the rear of rear access equipment.

**3.02 WORKMANSHIP**

- A. Electrical work shall meet or exceed the standards of installation and workmanship set forth in the National Electrical Contractors Association publication entitled NECA 1-2015 Standard for Good Workmanship in Electrical Construction, except as otherwise modified in these Specifications or shown on the Drawings.
- B. The A/E or University reserves the right to direct the removal and replacement of any item which, in their opinion, does not present an orderly, neat or workmanlike appearance, provided that such item can be properly installed in an orderly way by methods usual in such work, or which does not comply with the contract drawings or these Specifications. Perform such removals or replacements when directed in writing by the A/E and at the Contractor's expense.

- C. The Electrical Contractor shall at all times keep the premises in a neat and orderly condition, and at the completion of the work shall properly clean up and cart away debris and excess materials.

**END OF SECTION**

## **SECTION 26 00 20 - WORK INCLUDED**

### **PART 2 GENERAL**

#### **1.01 SCOPE**

- A. Furnish all materials, labor, tools, transportation, incidentals and appurtenances to complete in every detail and leave in working order all items of work called for herein and shown on the accompanying Drawings.
- B. It is the intent that the ensuing work shall be complete in every respect and that any material or work not specifically mentioned or shown on the Drawings, but necessary to fully complete the work, shall be furnished.

#### **1.02 COORDINATION OF PLANS AND SPECIFICATIONS**

- A. Contact the A/E immediately if there is any question regarding the meaning or intent of either the Plans or Specifications, or upon noticing any discrepancies or omissions in either the Plans or Specifications.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

#### **3.01 SITE VISITATION**

- A. It is highly recommended that the Bidder visit the project site to become fully informed concerning all conditions affecting the scope of work.

#### **3.02 SUPERVISION OF WORK**

- A. The Contractor shall have in charge of the work, at all times during construction, a competent superintendent with a significant experience in the work to be done under this Specification.
- B. Refer to the Specifications covering all branches of the work and keep fully informed of the progress of general construction. Install all work that is concealed and built into the building in sufficient time to insure proper location without delays to the work of the other trades. Properly attend to the work during the process of building-in to prevent misalignment and damage.

#### **3.03 EXISTING WORK AND DEMOLITION**

- A. Suitably and adequately protect the existing work within, and immediately adjacent to, the new work areas from damage and injury during the process of installing the work under this Contract. Existing work that has been harmed, damaged or injured as a result of the Electrical Contractor's operations shall be repaired, restored or replaced at the Electrical Contractor's expense.
- B. Revise existing wiring as indicated or required. Existing work that remains shall be left in first class condition, properly cleaned and reconnected.
- D. Branch circuit wiring from removed devices shall be removed back to the source.



- E. Reuse existing concealed conduit and flush mounted boxes when possible. All installed but unused boxes shall be blanked-off. All new conduit and wire in remodeled areas shall be run concealed where possible.

### **3.04 CUTTING AND PATCHING**

- A. Avoid cutting of concrete, masonry and other work. When necessary, cutting shall be done, at the Electrical Contractor's expense, by the appropriate trade's person with such tools and methods as to prevent unnecessary damage to surrounding areas or equipment.
- B. Electrical Contractor shall give the General Contractor locations and sizes of all openings required for the installation of electrical equipment before walls are started. If it becomes necessary to cut into new work because of the failure of this Contractor to notify the General Contractor, then the General Contractor shall coordinate any necessary cutting by this Contractor.
- C. No cutting shall be done which will in any way reduce the structural strength of the building. Should such cutting be found necessary, the A/E must first be fully informed of, and consent to, the proposed operation.
- D. All cutting through poured concrete slabs and walls shall be done with core drills. No jackhammers will be allowed.
- E. Patching shall match existing surfaces in type and finish and shall be done by the General Contractor at the Electrical Contractor's expense. This includes patching existing ceilings and floors where required and patching holes left by removal of existing conduits, equipment, etc.
- F. Repair of damages created by this Contractor to newly painted or refinished areas shall be done by the General Contractor at the Electrical Contractor's expense in type and finish to match existing.
- G. All conduits, equipment, etc. that penetrates walls or floors shall have openings, sleeves, etc. filled and closed off to prevent the possible spread of fire or products of combustion through the wall or floor.
- H. Where required to maintain fire rating, openings shall be sealed utilizing 3M Brand Fire Barrier Penetration Sealing systems. Fire barrier or fire stop systems from Crouse-Hinds, Thomas & Betts or Dow Corning may be used at Contractor's option. This includes holes left due to removal of existing conduit, bus duct, etc.
- I. Use of power-actuated fasteners and anchors is prohibited by the University.

### **3.05 CLEANING AND PAINTING**

- A. All electrical equipment shall be kept dry and clean during the construction period.
- B. All finished surfaces of equipment furnished under this Contract shall be thoroughly cleaned of dirt. All scratched or damaged surfaces shall be touched up with matching materials before final acceptance of the work. No exposed ferrous metal surfaces shall be left unpainted. Touch-up all galvanized surfaces, if scratched, with two coats of aluminum paint.
- C. Prime and paint all steel hangers, boxes, straps, rods, etc. which are not provided with rust-protective finish or if the protective finish is damaged during installation. Paint is to be zinc chromate primer with aluminum bronze finish. This includes unfinished, mechanical and "exposed to view" locations.

- D. When all work is completed and has been satisfactorily tested and accepted by the A/E all fixtures, conduit and other exposed surfaces shall be thoroughly cleaned.
- E. All lamps in all fixtures shall be installed new and the entire system shall be checked for satisfactory operation.
- F. Dust must be held to a minimum when work is performed inside of the existing building.
- G. Paint all exposed bare conduit and boxes on ceilings and walls. Painting shall consist of two (2) coats of semi-gloss enamel paint, except on walls that are shown on the "Room Finish Schedule" to be painted under the "PAINTING" section of the Specifications. The A/E shall select colors.
- H. All painting shall be performed by the appropriate trade's person at the expense of this contractor.

**3.06 INTERRUPTION OF SERVICE AND UNIVERSITY'S OPERATION**

- A. Organize work such that the alterations to the existing electrical distribution system shall not leave any occupied areas, outside of the project area without electrical service during normal business work hours. Where the electrical distribution system has to be de-energized, the submit in writing a detailed method of interruption indicating elapsed time required for a switchover, time of the outage, and the date of the interruption. Written schedules shall be submitted for approval 10 working days prior to any interruption of the service and shall be kept updated daily with the General Trades Contractor and addressed at weekly construction meetings. Submit schedules to the University Project Manager, for approval.
- B. All interruptions of service shall be made when the load is at a minimum. Include necessary costs for overtime labor where service interruptions are required to be outside of normal daytime working hours.
- C. At no time shall the Electrical Contractor or their employees normally working on the project leave the facility during a time when any normally live circuits or feeders are disconnected.

**END OF SECTION**

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CONSTRUCTION DOCUMENTS  
SEPTEMBER 9, 2024  
OU PROJECT 23002

## **SECTION 26 00 30 - CODES AND FEES**

### **PART 1 GENERAL**

#### **1.01 CODES**

- A. All work performed under this Specification shall be done in accordance with the National Electrical Code NEC-2017 as prepared and published by the National Fire Protection Association; National Electrical Safety Code NESC-2017; and any applicable Federal, State or Local Codes:
  - 1. NFPA 70, National Electrical Code 2017
  - 2. Ohio Building Code 2011 including January 2016 update
  - 3. Ohio Fire Code 2011 2<sup>nd</sup> Printing

#### **1.02 PERMITS AND FEES**

- A. Refer to the General Conditions for Contractor responsibilities regarding permits. The A/E will obtain the general building permit.
- B. Submit fire alarm system shop drawings with the seal and signature of the manufacturer's qualified design professional to the A/E for review prior to submitting to the State for final plan approval.
- C. The contractor shall schedule all inspections and pay associated inspection fees.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

Not Applicable

### **END OF SECTION**



## **SECTION 26 01 20 - OPERATION AND MAINTENANCE MANUALS**

### **PART 1 GENERAL**

#### **1.01 OPERATION AND MAINTENANCE MANUALS**

- A. Furnish one (1) copy of the printed Operating and Maintenance Instructions for the Electrical Systems for review. Copy shall be neat, legible and bound in a hardback 3-ring notebook. Submit preliminary copy 45 days following the receipt of all approved shop drawings. After final approval, provide four (4) copies of Operation and Maintenance Manual for submittal to University. Final copies shall be submitted 30 days prior to training.
- B. Format:
- 1) The Title page shall include the Title of the Project, Address of the Project, Date of Submittals, Name and Address of Contractor, Name of A/E Architect and Name of A/E Engineer.
  - 2) Second page shall be the Index for the manual contents.
  - 3) The first section shall include a copy of each approved shop drawing and submittal with an index at the beginning of the section.
  - 4) The second section shall include a list that is the same as the submittal drawings of all equipment used on the project. List shall include each suppliers name and address.
  - 5) The third section shall include Operating and Maintenance Instructions. Manufacturer's maintenance manuals for equipment furnished under this Contract shall include such items as parts lists, procedures for performing normal maintenance functions, preliminary trouble shooting procedures and wiring diagrams.
  - 6) Brief but complete instructions for routine maintenance of each device.

### **PART 2 PRODUCTS**

Not Applicable

### **PART 3 EXECUTION**

#### **3.01 UNIVERSITY PERSONNEL INSTRUCTION**

- A. After placing systems in operation, thoroughly instruct designated Universities personnel on operation and maintenance of all equipment and systems.

**END OF SECTION**



## SECTION 26 01 26 - TESTS AND INSPECTIONS

### PART 1 GENERAL

#### 1.01 INSPECTIONS

- A. Obtain all inspections required by all laws, ordinances, rules, regulations or public authority having jurisdiction. Obtain certificates of such inspections and submit these to the A/E. Pay all fees, charges and other expenses in connection with inspections.
- B. Before any electrical work is covered, the A/E will inspect the electrical work completed at that time.
- C. When the Contractor determines all work is completed and working properly per the Contract Documents, he shall request a "Final" inspection by the A/E in writing. If more than one re-inspection is required after this final inspection, the Contractor shall bear all additional costs, including compensation for the A/E's additional necessary services. A final inspection will not be made until Operating and Maintenance Manuals and Test Reports are submitted and approved and all prior "Observation report" punch lists are completed, signed and returned to the A/E.
- D. All work shall be inspected by the Ohio Department of Commerce, Department of Industrial Compliance, 6606 Tussing Road, Reynoldsburg, Ohio. Upon completion of the work, the Electrical Contractor shall furnish to the A/E, a certificate of inspection and approval from said Department before final payment to the Contract will be allowed. Fee for inspections shall be a part of this Contract.

#### 1.02 OBSERVATION REPORTS

- A. During the course of construction, the A/E will prepare "Observation Reports" with a list of items found to be in need of correction. The Contractor shall correct all items listed. A space is provided on the form for the Contractor to note the completion of each item. All prior "Observation Report" items must be completed and the lists signed and returned to the A/E prior to making the final inspection. After the final list is issued, the same procedure applies.

#### 1.03 TESTS

- A. When the A/E makes final inspection of all electrical work, he will order tests to be performed as deemed necessary. These tests may include operation of lights, disconnect switches and other equipment, continuity of conduit system, grounding and insulation resistances and various system operations. This Contractor shall provide such assistance as required, including manpower and tools, to perform these tests and simulate control sequences. The Contractor, not the A/E, is responsible to turn on the systems and demonstrate they are operating properly.
- B. Submit data taken during such tests to the A/E. Pay all necessary professional fees involved in required testing of equipment.
- C. If the A/E determines that any work requires special inspection, testing or approval which "Part 3: Execution" does not include, he will, upon written authorization from the University, instruct the Contractor to order such special inspection, testing or approval. The Contractor shall give timely notice so the A/E may observe these inspections, tests or approvals. If such special inspection or testing reveals a failure of the work to comply with the requirements of the Contract Documents, the Contractor shall bear all costs thereof, including compensation for the A/E's additional services made necessary by such failure. Otherwise the University shall bear such costs, and an appropriate Change Order shall be issued.



- C. All signaling systems, such as fire alarm shall be checked out and tested by a qualified field representative of equipment vendor. A report shall be submitted to Engineer by vendor representative indicating results of such final check out and test. Final payment will not be approved until such report is submitted.

#### **1.04 UNACCEPTABLE WORK**

- A. Work shall be unacceptable when found to be defective or contrary to the Plans, Specifications or Codes specified, or accepted standards of good workmanship.
- B. The Contractor shall promptly correct all work found unacceptable by the A/E whether observed before or after substantial completion and whether or not fabricated, installed or completed. The Contractor shall bear all costs of correcting such unacceptable work, including compensation for the A/E's additional services made necessary thereby.

#### **1.05 GUARANTEE**

- A. This Contractor is responsible for all defects, repairs and replacements in materials and workmanship, for a period of one (1) year after final payment is approved by the A/E. Refer to the General Conditions.

### **PART 2 PRODUCTS**

Not Applicable.

### **PART 3 EXECUTION**

#### **3.01 LIGHTING**

- A. All lamps in all fixtures shall be installed new. The entire system shall be checked for satisfactory operation.

#### **3.02 PHASE ROTATION**

- A. Prove that all electrical equipment is connected for clockwise rotation (A-B-C).

#### **3.03 LOAD BALANCE**

- A. Prove that loads are balanced across all phases of panelboards.
- B. Obtain optimum phase balance under full load condition by reconnection of panelboard feeders at the main switchboard. Any panelboards requiring circuit changes for balance shall reflect these changes in the panel directory and wire color identification. Color change can be made with colored tape at panel.
- C. Pay special attention to prevent reverse rotation of motors during load balance and adjustments.

#### **3.04 RESISTANCE AND CONTINUITY**

- A. Provide insulation and grounding resistance and ground continuity tests of medium voltage cables, medium voltage transformer, power feeders, branch circuits or equipment on demand.

- B. Branch circuit and feeder equipment grounding shall have a resistance reading of 3 ohms or less.

**3.05 CONNECTIONS**

- A. Prove that mechanical connections are torqued to manufacturer's recommended UL and NEMA standards on demand.

**3.06 EQUIPMENT**

- A. Provide necessary electrical personnel and testing instruments as required to assist in installation testing.
- B. Retain the services of a manufacturer's certified technician to test and commission the Audio/Visual System. Each component of the system shall be programmed and tested for full functionality by the technician.

**END OF SECTION**



## **SECTION 26 05 00 - COMMON WORK RESULTS FOR ELECTRICAL**

### **PART 1 - GENERAL**

#### **1.01 ROUGH-IN**

- A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.
- B. Coordinate equipment rough-in requirements with Divisions 02 through 23.

#### **1.02 ELECTRICAL INSTALLATIONS**

- A. Coordinate electrical equipment and materials installation with other building components.
- B. Verify all dimensions by field measurements.
- C. Arrange for chases, slots, and openings in other building components to allow for electrical installations.
- D. Coordinate the installation of required supporting devices and sleeves to be set in poured in place concrete and other structural components, as they are constructed.
- E. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing-in the building.
- F. Install systems, materials, and equipment to conform to project requirements and approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Engineer.
- G. Systems, materials, and equipment, which will be exposed in finished areas shall be installed level and plumb, parallel and perpendicular to other building systems and components.
- H. Install electrical services and overhead equipment to provide the maximum headroom possible, where mounting heights are not detailed or dimensioned.
- I. Install electrical equipment to facilitate maintenance and repair or replacement of equipment components. Maintain code clearances in front of and about all electrical equipment. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- J. Coordinate the installation of electrical materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
- K. Include in the work all labor, materials, equipment, services, apparatus, drawings (in addition to the Contract Documents) as required to complete the intended work.

- L. Only new, clean and perfect equipment, apparatus, materials and supplies of latest design and manufacture shall be incorporated in the work in order to assure an electrical system of high quality.

### **1.03 CONNECTIONS TO EQUIPMENT AND APPLIANCES**

- A. In many instances the drawings show an outlet box and power supply for specific equipment, be it University or contractor furnished. It is to be understood, unless otherwise noted, that the work includes a connection from the box to the equipment or appliance. Verify circuit conductor quantities and sizes and overcurrent device number of poles and rating as well as any special grounding requirements, for all University furnished equipment and adjust the required work accordingly.

### **1.04 CUTTING AND PATCHING**

- A. General: Perform cutting and patching in accordance with Division 01 Section "Cutting and Patching." In addition to the requirements specified in Division 01, the following requirements apply:
  - 1. Perform cutting, fitting, and patching of electrical equipment and materials required to:
    - a) Uncover Work to provide for installation of ill-timed Work.
    - b) Remove and replace defective Work.
    - c) Remove and replace Work not conforming to requirements of the Contract Documents.
    - d) Remove samples of installed Work as specified for testing.
    - e) Install equipment and materials in existing structures.
    - f) Cut, remove, and legally dispose of selected electrical equipment, components, and materials as indicated, including, but not limited to, removal of electrical items indicated to be removed and items made obsolete by the new Work.
  - 2. Coordinate the cutting and patching of building components to accommodate the installation of electrical equipment and materials.
  - 3. Protect the structure, furnishings, finishes, and adjacent materials not indicated or scheduled to be removed.
  - 4. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent areas.

### **1.05 QUALITY ASSURANCE**

- A. Installer Qualifications: Engage an experienced Installer for the installation and application of sealers and access panels and access doors.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
- C. Provide UL Label on each fire-rated access door.

### **1.06 SEQUENCE AND SCHEDULING**

- A. Coordinate the shut-off and disconnection of electrical and communication services with the University and the utility companies.

## **PART 2 - PRODUCTS**

### **2.01 MISCELLANEOUS METALS**

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Non-shrink, Nonmetallic Grout: Premixed, factory-packaged, non-staining, non-corrosive, nongaseous grout, recommended for interior and exterior applications.
- F. Fasteners: Zinc-coated, type, grade, and class as required.

### **2.02 MISCELLANEOUS LUMBER**

- A. All lumber shall be fire treated.
- B. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.
- C. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated but not less than 15/32 inches.

### **2.03 ACCESS DOORS**

- A. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
- B. Frames: 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
- C. For installation in masonry, concrete, ceramic tile, or wood paneling: 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors.
- D. For gypsum wallboard or plaster: Perforated flanges with wallboard bead.
- E. For full-bed plaster applications: Galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.
- F. Flush Panel Doors: 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
- G. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

- H. Locking Devices: Flush, screwdriver-operated cam locks.
- I. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Bar-Co., Inc.
  - 2. J.L. Industries.
  - 3. Karp Associates, Inc.
  - 4. Milcor Div. Inryco, Inc.
  - 5. Nystrom, Inc.

### **PART 3 - EXECUTION**

#### **3.01 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting installation and application of sealants and access panels. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.02 ERECTION OF METAL SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

#### **3.03 ERECTION OF WOOD SUPPORTS AND ANCHORAGE**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- B. Select fastener sizes that will not 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 members.
- C. Attach to substrates as required to support applied loads.

#### **3.04 APPLICATION OF SEALERS**

- A. General: Comply with sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
  - 1. Comply with recommendations of ASTM C 962 for use of elastomeric sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
- C. Apply rated firestopping sealants at all penetrations of fire and smoke walls; at all penetrations of floors and at other locations as noted on the drawings or where required by code. Consider walls

that are common to different abutting buildings, to different additions to buildings, and to fire and smoke separations within buildings as requiring fire stopping sealant. Refer to architectural drawings. When in doubt, consult with Engineer or Architect.

1. Submit the following approval before ordering materials for fire stopping:
  - a. Fire stopping detail, including Underwriters Laboratories System Number, as listed in Volume 2 of the UL Fire Resistance Directory, for each different intended project application, such as cable tray penetration, conduit penetration, penetration of one-hour gypsum penetration, penetration of two hour concrete slab, etc.
  - b. Fire stopping material manufacturer. This manufacturer must be listed in the applicable UL System Number detail.
  - c. Submittals for approval by the engineer are not required for other items in this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

### **3.05 INSTALLATION OF ACCESS DOORS**

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

**END OF SECTION**





## **SECTION 26 05 19 – LOW-VOLTAGE CONDUCTORS AND CABLES**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

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

#### **1.2 SUMMARY**

- A. This Section includes wires, cables, electrical tape and connectors for power, lighting, signal, control and related systems rated 600 volts and less.

#### **1.3 SUBMITTALS**

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

#### **1.4 QUALITY ASSURANCE**

- A. Regulatory Requirements: Comply with provisions of the following code:
  - 1. NFPA 70 "National Electrical Code:"
    - a. Conform to applicable codes and regulations regarding toxicity of combustion products of insulating materials.
  - 2. UL Compliance: Provide components which are listed and labeled by Underwriters Laboratories under the following standards.
    - a. UL Std. 83 Thermoplastic-Insulated Wires and Cables
    - b. UL Std. 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
    - c. UL Std. 1569 Metal Clad Cables
  - 3. NEMA and ICEA Compliance: Provide components which comply with the following standards:
    - a. WC-5: Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
    - b. WC-7: Cross Linked Thermosetting
    - c. Polyethylene-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy
  - 4. IEEE Compliance: Provide components which comply with the following standard.
    - a. Std. 82: Test procedures for Impulse Voltage Tests on Insulated Conductors.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Insulated tap connector:
  - 1. Blackburn Series IPC
  - 2. Buchanon B-Tap
- B. Spring Wire Connectors for AWG sizes Number 14 to Number 10 in dry locations:
  - 1. 3M Scotchlok Y, R, G, and B
  - 2. Ideal Wingnut
  - 3. Thomas & Betts Type PT
- C. Threaded on Wire Connectors for AWG sizes Number 8 and larger:
  - 1. Raychem TCS (indoor)

2. Raychem WCSM (exterior)
- D. Spring Wire Connectors for AWG sizes Number 14 to Number 10 in wet and damp locations:
  1. King Technology "One-Step" Model King-4, 5, 6, 9 Silicone-Filled Safety Connectors
- E. Below Grade Wiring Connectors:
  1. 3M In-Line Cold Shrink Splice.
  2. King Technology "One-Step" Model King-4, 5, 6, 9 Silicone-Filled Safety Connectors.
- F. For connections of cables to buswork: Use two hole mechanical lugs if space allows, otherwise use one-hole lugs. Lugs to be Burndy universal terminal series KA, K2A or K3A as required or approved equal.
  1. Electrical Tape: Use 3M Super #88 electrical tape. 3M #33, #33+ or other tapes are not acceptable.

## **2.2 WIRES AND CABLES**

- A. General: Provide wire and cable suitable for the temperature, conditions and location where installed.
- B. Single Conductors for General Power and Lighting Circuits:
  1. Stranding: Provide stranded conductors for lighting circuits and non-vibrating power utilization equipment utilizing Number 10 AWG and smaller and stranded conductors for Number 8 AWG and larger. Provide stranded conductors, regardless of size, for connections to vibrating equipment such as motors and transformers.
  2. Conductors of AWG Number 10 and smaller for lighting circuits and non-vibrating power utilization equipment may be stranded if used with devices, lugs and connectors specifically applicable for stranded conductors. Stranded conductors are not to be used with screw head binding, such as with side wired devices. Proper back-wired or pressure devices UL listed for stranded conductor termination must be used where stranded conductors are selected.
  3. Use stranded conductors for control circuits.
  4. Conductor Material: Copper for all wires and cables.
  5. Insulation: Provide XHHW or THHN or THWN insulation for all conductors. Provide XHHW or THWN for all conductors installed outdoors or underground
  6. Color Coding for phase identification in accordance with Part 3 below.
- C. Wiring for other systems such as fire alarm, paging, communications, etc., shall be as specified in those sections of these specifications.

## **PART 3 - EXECUTION**

### **3.1 WIRING METHOD**

- A. Use the following wiring methods as indicated:
  1. Wire: Install all wire in conduit raceway

### **3.2 PREPARATION**

- A. Completely and thoroughly swab raceway before installing wire.

### **3.3 INSTALLATION OF WIRES AND CABLES**

- A. General: Install electrical cables, wires, and connectors in compliance with NEC.
- B. Coordinate cable installation with other Work.
- C. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant where necessary.

- D. Use pulling means including, fish tape, cable, rope, and basket weave wire and cable grips which will not damage cables or raceways. Do not use rope hitches for pulling attachment to wire or cable. Do not exceed maximum tensile strength of conductor or grip. Do not exceed maximum sidewall pressure limitations of cables.
- E. Conceal all cable in finished spaces.
- F. Keep conductor splices to minimum.
- G. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
- H. Use splice and tap connectors which are compatible with conductor material.
- I. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than Number 10 AWG cabled in individual circuits. Make terminations so there is no more than 1/8 inch of exposed bare conductor at the terminal.
- J. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL 486A and UL 486B.
- K. Verify that interior of building has been protected from weather.
- L. Verify that mechanical work likely to damage wire and cable has been completed.
- M. Install products in accordance with manufacturer's instructions.
- N. Use conductor not smaller than Number 12 AWG for power and lighting circuits.
- O. Single conductors used for control circuits shall not be smaller than Number 14 AWG.
- P. Use Number 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet, unless drawings requirements are more stringent.
- Q. Use Number 10 AWG conductors for 20 ampere, 277 volt branch circuits longer than 200 feet, unless drawings requirements are more stringent.
- R. Feeder conductors shall be continuous and shall not contain splices.
- S. Neatly train wiring inside boxes, equipment, and panelboards. Observe NEC 310- 15 (b)(2)(a) adjustment factors.
- T. Clean conductor surfaces before installing lugs and connectors.
- U. Make splices, taps, and terminations to carry full ampacity of conductors.
  - 1. Install splices and taps which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.
  - 2. Use splice and tap connectors which are compatible with conductor material.
- V. Above grade:
  - 1. Use pre-molded insulated tap connectors for copper conductor splices and taps, Number 8 AWG and larger. Insulate with UL listed insulating cover supplied by same manufacturer as connector.

2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, Number 10 AWG and smaller.
3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor, or three layers of tape, whichever is greater.

W. Below grade:

1. Use specified insulated connectors suitable and approved for below grade wiring connectors. Ensure that conductors do not apply tension to splice.

### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Identify each conductor with its circuit Number or other designation indicated on Drawings.

### 3.5 FIELD QUALITY CONTROL

- A. Inspect wire for physical damage and proper connection.

- B. Measure tightness of bolted connections with properly scaled and calibrated torque tool and compare torque measurements with manufacturer's recommended values.

- C. Before energizing, verify continuity and isolation of each branch circuit conductor.

D. Conductor Color Coding:

1. Color code secondary service, feeder, and branch circuit conductors, as follows:

208Y/120 Volts	Phase	480Y/277 Volts
Black	A	Yellow
Red	B	Orange
Blue	C	Brown
White	Neutral	Gray
Green	Ground	Green

2. Permanently post this identification table at all branch circuit panelboards.

- E. Conductor Color Coding Methods: Use conductors with color factory-applied the entire length of the conductors except that the following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than Number 6 AWG.

F. For phase conductors:

1. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 4 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1/2 or 3/4 inch-wide 3M Scotch #35 tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
2. In lieu of pressure-sensitive tape, colored non-conductive cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. For neutral conductor:

1. Same as for phase conductors except that three continuous white strips, factory applied, shall be used. Cable ties not allowed.

H. For ground conductor:

1. Same as for phase conductors except that cable ties are not allowed.

- I. Prior to energizing, test wires and cables for electrical continuity and for short circuits.

- J. Subsequent to wire and cable hook-ups, energize circuits and demonstrate proper functioning. Correct malfunctioning units, and retest to demonstrate compliance.

**END OF SECTION**



## **SECTION 26 05 26 - GROUNDING AND BONDING**

### **PART 1 - GENERAL**

#### **1.01 SUMMARY**

- A. This Section includes solid grounding of electrical systems and equipment. It includes 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.

#### **1.02 SUBMITTALS**

- A. Submittals for approval by the Engineer of products to be used are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
- B. Submit the following to the Engineer:
  - 1. Report of field tests and observations of the type indicated under Part 3 - Execution.

#### **1.03 QUALITY ASSURANCE**

- A. Listing and Labeling: Provide products specified in this Section that are listed and labeled for the specific purposes by Underwriter's Laboratories.
- B. Electrical Component Standard: Components and installation shall comply with NFPA 70, "National Electrical Code" (NEC).
- C. UL Standard: Comply with UL 467, "Grounding and Bonding Equipment."

### **PART 2 - PRODUCTS**

#### **2.01 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. A.B. Chance Co.
  - 2. Blackburn Co.
  - 3. Erico Products, Inc.
  - 4. Ideal Industries, Inc.
  - 5. Kearney-National.
  - 6. McGill Mfg.
  - 7. O-Z/Gedney Co.
  - 8. Raco, Inc.
  - 9. Thomas & Betts Corp.

#### **2.02 GROUNDING AND BONDING PRODUCTS**

- A. Products: Of types indicated and of sizes and ratings to comply with NEC. Where types, sizes, ratings, and quantities indicated are in excess of NEC requirements, the more stringent requirements and the greater size, rating, and quantity indications govern.
- B. Conductor Materials: Copper.



## **2.03 WIRE AND CABLE CONDUCTORS**

- A. General: Comply with Division 26 Section "Low-Voltage Electrical Power and Cables." Conform to NEC Table 8, except as otherwise indicated, for conductor properties, including stranding.
- B. Equipment Grounding Conductor: Copper, green insulated.
- C. Grounding Electrode Conductor: Copper, stranded cable.
- D. Bare Copper Conductors: Conform to the following:
  - 1. Solid Conductors: ASTM B-3.
  - 2. Assembly of Stranded Conductors: ASTM B-8.
  - 3. Tinned Conductors: ASTM B-33.

## **2.04 MISCELLANEOUS CONDUCTORS**

- A. Ground Bus: Bare annealed copper bars of rectangular cross section.
- B. Braided Bonding Jumpers: Copper tape, consisting of braided No. 30 gage bare copper wire, terminated with copper ferrules.
- C. Bonding Strap Conductor/Connectors: Soft copper, 0.05 inch thick and 2 inches wide, except as indicated.
- D. CONNECTOR PRODUCTS
- E. General: Listed and labeled as grounding connectors for the materials used.
  - 1. Pressure Connectors: High-conductivity-plated units.
  - 2. Bolted Clamps: Heavy-duty units listed for the application.
  - 3. Exothermic Welded Connections: Provided in kit form and selected for the specific types, sizes, and combinations of conductors and other items to be connected.

## **2.05 GROUNDING ELECTRODES**

- A. Ground Rods: Copper-clad steel with high-strength steel core and electrolytic-grade copper outer sheath, molten welded to core.
  - 1. Size: 3/4 inch by 10 feet.

## **PART 3 - EXECUTION**

### **3.01 APPLICATION**

- A. Equipment Grounding Conductor Application: Comply with NEC Article 250 for sizes and quantities of equipment grounding conductors, except where larger sizes or more conductors are indicated.
- B. Install separate insulated equipment grounding conductors with circuit conductors for all feeders and branch circuits.
- C. Nonmetallic Raceways: Install an insulated equipment ground conductor in nonmetallic raceways containing power conductors.
- D. Air Duct Equipment Circuits: Install an insulated equipment-grounding conductor to duct-mounted electrical devices operating at 120-V and above including air cleaners and heaters. Bond the conductor to each such unit and to the air duct.

- E. Water Heater, Heat Tracing, and Anti-Frost Heater Circuits: Install separate insulated equipment ground conductor to each electric water heater, heat tracing, and surface anti-frost heating cable. Bond this conductor to heater units, piping, and connected equipment and components.
- F. Underground Conductors: Bare, stranded copper except as otherwise indicated.
- G. Signal and Communications: For telephone, alarm, and communication systems, provide a green insulated copper conductor in raceway from the grounding electrode system to each terminal cabinet or central equipment location. Size of the conductor shall be minimum #4 copper or as shown on drawings, whichever is larger.
- H. Separately derived systems required by NEC to be grounded shall be grounded in accordance with the NEC.
- I. Bond electrical system grounding, telephone, CATV, other communications systems, water piping, gas piping, and other piping systems together.

### **3.02 INSTALLATION**

- A. Ground Rods: Interconnect ground rods with bare conductors buried at least 24 inches below grade. Connect bare-cable ground conductors to ground rods by means of exothermic welds except as otherwise indicated. Make these connections without damaging the copper coating or exposing the steel. Drive rods until tops are 6 inches below finished floor or final grade except as otherwise indicated.
- B. Metallic Water Service Pipe: Provide insulated copper ground conductors, sized as indicated, in conduit from the building main service equipment, or the ground bus, to main metallic water service entrances to the building. Connect ground conductors to the main metallic water service pipes by means of ground clamps. Where a dielectric main water fitting is installed, connect the ground conductor to the street side of the fitting. Install a grounding jumper around dielectric fittings. When the grounding electrode conductor is routed in metal conduit, bond the conduit to the conductor at each end.
- C. Braided-Type Bonding Jumpers: Install to connect ground clamps on water meter piping to bypass water meters electrically. Use elsewhere for flexible bonding and grounding connections.
- D. Route grounding conductors along the shortest and straightest paths possible without obstructing access or placing conductors where they may be subjected to strain, impact, or damage, except as indicated.
- E. Bond interior metal piping systems and metal air ducts to equipment ground conductors of pumps, fans, electric heaters, and air cleaners serving individual systems.
- F. Bond all communications conduits, sleeves, cable trays, cabinets, and equipment racks. For conduits terminating at cable trays, bond the conduit to the cable tray.

### **3.03 CONNECTIONS**

- A. General: Make connections in such a manner as to minimize possibility of galvanic action or electrolysis.
- B. Make connections with clean bare metal at points of contact.
- C. Aluminum to steel connections shall be with stainless steel separators and mechanical clamps.

- D. Aluminum to galvanized steel connections shall be with tin-plated copper jumpers and mechanical clamps.
- E. Coat and seal connections involving dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- F. Exothermic Welded Connections: Use for connections to structural steel and for underground connections except those at test wells. Install at connections to ground rods and plate electrodes. Comply with manufacturers written recommendations. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.
- G. Terminate insulated equipment grounding conductors for feeders and branch circuits with pressure-type grounding lugs. Where metallic raceways terminate at metallic housings, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to the ground bus or lug in the housing. Bond conduits at both entrances and exits with grounding bushings and bare grounding conductors.
- H. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A and UL 486B.
- I. Compression-Type Connections: Use hydraulic compression tools to provide the correct circumferential pressure for compression connectors. Use tools and dies recommended by the manufacturer of the connectors. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on the ground conductor.

### **3.04 FIELD QUALITY CONTROL**

- A. Tests: The maximum acceptable impedance to ground at the service entrance is 5 ohms. Subject the completed grounding system to a resistance test at each location where a ground resistance test is specified, and at service disconnect enclosure ground terminal, and at ground test wells. Measure ground resistance without the soil being moistened by any means other than natural precipitation or natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance. Notify the Engineer of the scheduled testing time at least 48 hours in advance of the scheduled test time. Perform tests by the fall of potential method in accordance with Section 9.03 of IEEE 81, "Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System."
- B. Report: Prepare test reports of the ground resistance at each test location. Buried ground systems shall be tested before pavement is installed in order to allow for possible changes to the grounding system. Include observations of weather and other phenomena that might affect test results. Submit results of testing to the Engineer.
- C. Deficiencies: When directed by the Engineer, modify the grounding system to reduce resistance values. Where measures are directed that exceed those indicated in the provisions of the Contract, covering changes will apply.

**3.05 CLEANING AND ADJUSTING**

- A. Restore surface features at areas disturbed by excavation and reestablish original grades except as otherwise indicated. Where sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other Work to their original condition. Include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, or mulching. Maintain disturbed surfaces and restore. Restore disturbed paving as indicated.

**END OF SECTION**



## **SECTION 26 05 29 - HANGERS AND SUPPORTS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.
- B. Refer to other Division 26 sections for additional specific support requirements that may be applicable to specific items.

#### **1.2 SUBMITTALS**

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."
- B. Electrical components shall be listed and labeled for the specific intended purpose by Underwriters Laboratories, Inc.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Slotted Metal Angle and U-Channel Systems:
    - a. Allied Tube & Conduit
    - b. American Electric
    - c. B-Line Systems, Inc.
    - d. Cinch Clamp Co., Inc.
    - e. GS Metals Corp.
    - f. Haydon Corp.
    - g. Kin-Line, Inc.
    - h. Unistrut Diversified Products
  - 2. Conduit Sealing Bushings:
    - a. Bridgeport Fittings, Inc.
    - b. Killark Electric Mfg. Co.
    - c. O-Z/Gedney
    - d. Raco, Inc.
    - e. Red Seal Electric Corp.
    - f. Spring City Electrical Mfg. Co.
    - g. Thomas & Betts Corp.

## 2.2 COATINGS

- A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic.

## 2.3 MANUFACTURED SUPPORTING DEVICES

- A. Raceway Supports: Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, wall brackets, and spring steel clamps.
- B. "Mineralac" type supports and "Unistrut" type one bolt supports with square ends shall not be used at any location.
- C. Fasteners: Types, materials, and construction features as follows:
  - 1. Expansion Anchors: Carbon steel wedge or sleeve type.
  - 2. Toggle Bolts: All steel springhead type.
- D. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit, or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps, and cap screws.
- E. Cable Supports for Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug for non-armored electrical cables in riser conduits. Provide plugs with number and size of conductor gripping holes as required to suit individual risers. Construct body of malleable-iron casting with hot-dip galvanized finish.
- F. U-Channel Systems: 16-gauge steel channels, with 9/16-inch-diameter holes, between one and one half and two and one half inches on center, in top surface. Provide fittings and accessories that mate and match with U-channel and are of the same manufacture.

## 2.4 FABRICATED SUPPORTING DEVICES

- A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.
- B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.
- C. Pipe Sleeves: Provide pipe sleeves of one of the following:
  - 1. Interior Dry Locations: Fabricate from Schedule 40 galvanized steel pipe or Schedule 40 PVC plastic pipe.
  - 2. Exterior or Interior Wet or Damp Locations: Fabricate from Schedule 40 PVC plastic pipe.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

- B. "Mineralac" type supports and "Unistrut" type one bolt supports with square ends shall not be used at any location.
- C. Coordinate with the building structural system and with other electrical installation.
- D. Raceway Supports: Comply with the NEC and the following requirements:
  - 1. Conform to manufacturer's recommendations for selection and installation of supports.
  - 2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four. Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
  - 3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
  - 4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
  - 5. Support individual horizontal raceways by separate pipe hangers. Spring steel fasteners may be used in lieu of hangers only for 1 inch and smaller raceways serving branch circuits, telephone and data above suspended ceilings only. For hanger rods with spring steel fasteners, use 1/4-inch-diameter or larger threaded steel. Use spring steel fasteners that are specifically designed for supporting single conduits or tubing.
  - 6. Space supports for raceways in accordance with Table I of this section. Space supports for raceway types not covered by the above in accordance with NEC.
  - 7. Support exposed and concealed raceway within 3 feet of boxes, access fittings, device boxes, cabinets or other raceway terminations.
  - 8. In vertical runs, arrange support so the load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.
- E. Vertical Conductor Supports: Install simultaneously with installation of conductors.
- F. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.
- G. Sleeves: Install in concrete slabs and walls and all other fire-rated floors and walls for raceways and cable installations. Provide insulated bushings at each end of sleeve. For sleeves through fire rated-wall or floor construction, apply UL-listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.
- H. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.
- I. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, motor control centers, disconnect switches, and control components in accordance with the following:
  - 1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.



2. Holes cut to depth of more than 1-1/2 inches in reinforced concrete beams or to depth of more than 3/4 inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

TABLE I: SPACING FOR RACEWAY SUPPORTS

Raceway Size (Inches)	No. of Conduits in Run	Location	Maximum Spacing of Supports (Feet)		
			RMC & IMC*	EMT	
1) HORIZONTAL RUNS					
1/2, 3/4	1 or 2	Flat ceiling or wall.	5	5	
1/2, 3/4	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	7	7	
1/2, 3/4, 1	3 or more	Any location.	7	7	
1 & larger	1 or 2	Flat ceiling or wall.	6	6	
1 & larger	1 or 2	Where it is difficult to provide supports except at intervals fixed by the building construction.	10	10	
1 & larger	3 or more	Any location.	10	10	
Any	--	Concealed.	10	10	
2) VERTICAL RUNS					
1/2, 3/4	--	Exposed.	7	7	
1, 1-1/4	--	Exposed.	8	8	
1-1/2 and larger	--	Exposed.	10	10	
Up to 2	--	Shaftway.	14	10	
2-1/2	--	Shaftway.	16	10	
3 & larger	--	Shaftway.	20	10	
Any	--	Concealed.	10	10	

\*Maximum spacing for IMC above apply to straight runs only. Otherwise the maximums for EMT apply.

Abbreviations:     EMT     Electrical metallic tubing  
                           IMC     Intermediate metallic conduit  
                           RMC     Rigid metallic conduit

**END OF SECTION**

## SECTION 26 05 33 - RACEWAYS AND BOXES

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
- B. Raceways include the following:
  - 1. Rigid metal conduit
  - 2. Intermediate metal conduit
  - 3. Rigid non-metallic conduit and duct
  - 4. Electrical metallic tubing (EMT)
  - 5. Flexible metal conduit
  - 6. Liquidtight flexible conduit
  - 7. Wireway
  - 8. Surface raceways
  - 9. Boxes, enclosures, and cabinets include the following:
    - a. Device boxes
    - b. Floor boxes
    - c. Outlet boxes
    - d. Pull and junction boxes
    - e. Cabinets and hinged cover enclosures
    - f. Conduit bodies

#### 1.2 SUBMITTALS

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled by Underwriter's Laboratories for the specific purpose and comply with the following standards:
  - 1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
  - 2. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.
  - 3. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
  - 4. ANSI/NFPA 70 - National Electrical Code.
  - 5. NECA 1 "Standard practice of Good Workmanship in Electrical Construction (ANSI)."
  - 6. NEMA TC 2 - Electrical Plastic Conduit (EPC-40 and EPC-80).
  - 7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.
- C. Coordinate layout and installation of raceway and boxes with other construction elements to ensure adequate headroom, working clearance, and access.

## **PART 2 - PRODUCTS**

### **2.1 CONDUIT REQUIREMENTS**

- A. General: Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements, and comply with applicable portions of NEC for raceways.
- B. Minimum Size: 3/4 inch, switch legs may be 1/2 inch minimum, and fixture whips may be 1/2 inch minimum.

### **2.2 METAL CONDUIT**

- A. Rigid Steel Conduit: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to inside and outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.1 and listed and labeled under UL 6.
- B. Intermediate Metal Conduit: Conduit to be seamless, hot dipped galvanized rigid steel. Threads to be cut and ends chamfered prior to galvanizing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to be listed and labeled under UL 1242.
- C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit. Couplings for rigid steel conduit and IMC to be single piece threaded, cadmium plated malleable iron. Conduit bodies may be aluminum. Hubs for box connection to be two-piece with outer internally threaded hub to receive conduit and inner locking ring with bonding screw. Expansion fittings shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney AX series, complete with bonding jumpers and hardware.
- D. Raintight Sealing Hubs: Two piece type with outer internally-threaded hub to receive conduit, inner locking ring with bonding screw, insulated throat, and V-shaped ring or O-ring .
  - 1. Manufacturers: Thomas & Betts H series or Bridgeport.

### **2.3 FLEXIBLE METAL CONDUIT AND FITTINGS**

- A. Description: Interlocked steel or aluminum construction.
- B. Flexible Metal Steel Conduit: Conduit to be constructed of spirally wrapped, convoluted hot dip galvanized steel strip. Zinc coating to cover both sides and all edges of steel strip. Convolutions to be interlocked to prevent separation when conduit is bent at radius equal to 4-1/2 times conduit O.D. Conduit to be listed and labeled under UL 1 - 1985.
- C. Flexible Metal Aluminum Conduit: Conduit to be constructed of spirally wrapped, convoluted aluminum strip. Convolutions to be interlocked to prevent separation when conduit is bent at radius equal to 4-1/2 times conduit O.D. Conduit to be listed and labeled under UL 1 - 1985.
- D. Fittings: ANSI/NEMA FB 1 -1988.

#### **2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT and FITTINGS**

- A. Liquidtight flexible metal conduit and fittings shall meet the same construction specifications as flexible metal conduit above and shall have an outer PVC jacket.
- B. Liquidtight Flexible Metal Steel Conduit: Conduit to be listed and labeled under UL 360 - 1986.
- C. Liquidtight Flexible Metal Aluminum Conduit: Conduit to be listed and labeled.
- D. Liquidtight flexible conduit connectors to consist of body, cone (ferrule), sealing gland, and nut. Fitting to be UL 514B - 1987 listed for grounding. Body to be cadmium plated malleable iron and have male and female thread for attachment to box or conduit as required.

#### **2.5 ELECTRICAL METALLIC TUBING (EMT) and FITTINGS**

- A. Description: Conduit to be seamless, hot dipped or electro-galvanized steel tubing. Galvanizing to provide zinc coating fused to outside walls of conduit. Provide an enamel lubricating coating on the inside of the conduit. Conduit to conform to ANSI C80.3 - 1983 and listed and labeled under UL 797 - 1983.
- B. Provide steel compression connectors and couplings for interior EMT fittings. Connectors and fittings to be cadmium plated, zinc plated steel, or malleable iron fittings and include insulated throats. Die cast fittings, components, and indenter type couplings and connectors are not allowed.
- C. Expansion fittings for use with EMT shall allow for a minimum of four inches of movement and shall be similar to O-Z Gedney TX series, complete with bonding jumpers and hardware.

#### **2.6 CONDUIT BUSHINGS**

- A. Bushings for terminating conduits smaller than 1-1/4 inches are to have flared bottom and ribbed sides, with smooth upper edges to prevent injury to cable insulation. Install insulated type bushings for terminating conduits 1-1/4 inches and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing. Bushings to have screw type grounding terminal.

#### **2.7 RIGID NONMETALLIC CONDUIT AND DUCT**

- A. Description:
  - 1. Rigid Non-Metallic Conduit: Conduit to be PVC, Schedule 40 or Schedule 80 as indicated, conforming to ANSI, NEMA specifications and be listed and labeled under UL 651. May be used in or under concrete slabs on grade and in exterior when concrete encased {3 in. minimum cover),
- B. Fittings and Conduit Bodies:
  - 1. Rigid non-metallic conduit connectors and couplings to be manufactured per NEMA TC-3 and UL 651 listed.

#### **2.8 NONMETALLIC CONDUIT FITTINGS**

- A. PVC Conduit and Tubing Fittings: NEMA TC 3; match to conduit, tubing type and material. Expansion fittings shall allow for six inch movement, and shall be similar to Carlon E945 series.

## 2.9 WIREWAYS

- A. Material: Galvanized sheet steel sized as indicated or required, whichever is greater.
  - 1. Wireway up to 6 inch by 6 inch cross section shall be minimum 16 gauge.
  - 2. Wireway larger than 6 inch by 6 inch cross section shall be minimum 14 gauge.
- B. Fittings and Accessories: Include couplings, offsets, elbows, expansion fittings, seismic connections, adapters, hold-down straps, end caps, and other fittings to match and mate with wireway as required for complete system.
- C. Select features where not otherwise indicated, as required to complete wiring system and to comply with NEC.
- D. Wireway Covers: Hinged type.
- E. Finish: Manufacturer's standard enamel finish.

## 2.10 SURFACE RACEWAY

- A. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceway.
- B. Surface Metal Raceway: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating suitable for painting.
- C. Reference standard: Wiremold 2400 series (match existing).

## 2.11 OUTLET AND DEVICE BOXES

- A. Outlet Boxes shall be constructed in accordance with National Electrical Code Article 370. Outlet boxes shall be sized for the volume required by the National Electrical Code, but in no case shall they be less than 1-1/2 inches deep.
  - 1. Indoor: Galvanized steel, knockouts as required.
  - 2. Exterior boxes or exposed interior wet or damp locations: Cast, deep type, corrosion proof fasteners, watertight, gasketed, threaded hubs.
  - 3. For suspended or surface-mounted fixtures:
    - a. Outlet boxes shall be 4 inch octagonal or 4 inch square, in accordance with devices used. Furnish outlet boxes with fixture studs where required. Provide 4 inch octagonal and square outlet boxes for all exposed conduit work with fixture extension pan or deep fixture canopy to enclose the outlet box.
  - 4. For recessed fixtures:
    - a. 4 inch octagonal or square. Minimum 1-1/2 inches deep and complete with blank cover.
  - 5. Provide corrosion-resistant steel knockout closures for unused openings.
- B. Sheet Metal Boxes: NEMA OS 1. Boxes for receptacle, telephone and data outlets shall be 4-11/16 inches square by 2-1/8 inches deep and shall be provided with extension rings.
- C. Sheet metal boxes for lighting fixtures shall be 4 inch octagonal or square according to fixture hardware requirements.. Boxes shall be at least 1-1/2 inches deep.
- D. Cast Metal Boxes: NEMA FB 1, type FD, cast ferrous alloy box with gasketed cover.

## **2.12 FLOOR BOXES**

- A. Floor Box: Cast metal, fully adjustable, rectangular or as scheduled.

## **2.13 PULL AND JUNCTION BOXES**

- A. Small Sheet Metal Boxes: NEMA OS 1. Flush-mounted boxes shall have an overlapping cover.
- B. Cast Metal Boxes: NEMA FB 1, cast aluminum with gasketed cover.
- C. Surface-mounted boxes: Screw-on or hinged cover.
- D. Covers shall be the same material as the box. Cover shall be on the largest access side of the box, unless otherwise indicated.
- E. Boxes located outdoors above ground shall be raintight and gasketed cast aluminum.
- F. Boxes located in the ground or in wet or damp locations shall be cast malleable iron having cadmium finish, unless otherwise indicated.

## **2.14 CABINETS AND ENCLOSURES**

- A. Hinged Cover Enclosures: Per NEMA 250, steel enclosure with continuous hinge cover and flush latch. Finish inside and out with manufacturer's standard enamel.
- B. Cabinets: Type 1, per NEMA 250, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage, and include accessory feet where required for freestanding equipment.

## **2.15 CONDUIT BODIES**

- A. Cast metal of type, shape and size to fit location and conduit.
- B. Constructed with threaded conduit ends, removable cover, corrosion-resistant screws.

## **2.16 UNDERGROUND WALL PENETRATION SEALS**

- A. New Walls: Seal assembly shall consist of a matched sleeve and seal assembly. Sleeve shall be model WS steel sleeve and seal shall consist of interconnected rubber links, which shall create a water-tight and gas-tight seal. Sleeves and seals shall be PSI-Thunderline "Link-Seal" model C.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces to receive raceways, boxes, enclosures, and cabinets for compliance with installation tolerances and other conditions affecting performance of the raceway system. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.2 WIRING METHODS FOR 600 VOLTS AND LESS

- A. Outdoor, Exposed Interior, and Interior Wet and Damp Locations:
  - 1. Underground Installations or under slab on grade: Use Schedule 40 PVC conduit a minimum of 3" below slab. Use rigid steel conduit for stub ups from slab and from below grade
  - 2. Above Grade, Exposed Interior below 8' from floor, and Interior Wet and Damp Locations: Use rigid aluminum conduit. Provide spacers to maintain a minimum of 1/4 inch gap between the conduit and masonry and other surfaces detrimental to aluminum conduit.
  - 3. Connections to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Flexible Liquidtight flexible metal conduit.
  - 4. Boxes and Enclosures: NEMA Type 3R or Type 4, unless noted otherwise on the drawings.
  
- B. Dry Interior Locations:
  - 1. Concealed in Walls and Ceilings: Use electrical metallic tubing unless noted otherwise on drawings.
  - 2. Exposed: Unless otherwise indicated on the drawings, the following shall apply:
    - a. Use rigid metal or intermediate metal conduit within 6 feet 0 inches of the floor in areas subject to physical damage such as mechanical areas, loading dock areas, generator rooms and storerooms. Electrical metallic tubing may be used above 6 feet 0 inches from the floor and where not subject to physical damage. Rooms dedicated solely to electrical equipment do not require rigid metal or intermediate metal conduit, unless required elsewhere in the documents or by code, such as for medium voltage circuits.
  - 3. Connections to Vibrating Equipment (including transformers and hydraulic, pneumatic, or electric solenoid or motor-driven equipment): Liquid-tight flexible metal conduit. Use Liquidtight flexible metal conduit where subject to oil drips or spray and all other areas which are not completely free of spray, vapor and liquids.
  - 4. Boxes and Enclosures: NEMA Type 1, unless noted otherwise on the drawings.
  - 5. Concealed in Interstitial space (crawl space): Use nonmetallic conduit unless noted otherwise on drawings.

### 3.3 INSTALLATION

- A. Do not reduce the indicated sizes of raceways.
- B. Do not install any raceway in concrete slabs. Under slab conduits to be a minimum of 3" below slab.
- C. Raceway routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system. Verify field measurements and routing and termination locations of raceway prior to rough-in. Raceways are not to cross pipe shafts, or ventilating duct openings, nor are they to pass through HVAC ducts. Support riser raceway at each floor level with clamp hangers. Maintain adequate clearance between raceway and piping.
- D. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer's written instructions.
- E. Avoid moisture traps; provide junction box with drain fitting at low points in raceway system.

- F. Use conduit bodies to make sharp changes in direction, as around beams. Use hydraulic one-shot bender when field fabricated elbows are required for bends in metal conduit larger than 2 inch size.
- G. Expansion:
  - 1. Provide suitable fittings to accommodate expansion and contraction where raceway crosses seismic and expansion joints. Install expansion fittings in the full open position if installed during a period of lowest expected temperature, and in the fully closed position if installed during a period of highest expected temperature. Install at proportionate intermediate position for intermediate temperatures.
- H. Conceal conduit and EMT, unless otherwise indicated, within finished walls, ceilings, and floors.
- I. 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.
- J. Install raceways level and square and at proper elevations. Provide adequate headroom. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- K. Complete raceway installation before starting conductor installation.
- L. Use temporary closures to prevent foreign matter from entering raceway.
- M. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portion of bends is not visible above the finished slab.
- N. Elbows for underground conduits that turn up above grade shall be rigid metallic.
- O. Make bends and offsets so the inside diameter is not reduced. Unless otherwise indicated, keep the legs of a bend in the same plane and the straight legs of offsets parallel.
- P. Run concealed raceways with a minimum of bends in the shortest practical distance considering the type of building construction and obstructions, except as otherwise indicated.
- Q. Install exposed raceways parallel to or at right angles to nearby surfaces or structural members, and follow the surface contours as much as practical.
- R. Run parallel or banked raceways together, on common supports where practical and make bends from same center line to make bends parallel. Use factory elbows only where they can be installed parallel; otherwise, provide field bends for parallel raceways.
- S. Raceways passing through exterior below-grade slabs:
  - 1. New walls: Install sleeve unit before wall is poured and install rubber link sealing unit between wall sleeve and raceway after concrete has cured and raceway is run. Ensure that bolt heads remain accessible on inside of building wall.
- T. Terminate rigid and IMC conduits in threaded hubs. Screw the raceway or fitting tight into the hub so the end bears against the wire protection shoulder. Use raintight sealing hubs with neoprene O-ring between exterior of enclosure and exterior half of hub where exposed to weather or other wet locations.



- U. Install pull wires in empty raceways. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200-lb tensile strength. Leave not less than 12 inches of slack at each end of the pull wire. Test conduits required to be installed, but left empty, with ball mandrel. Clear any conduit which rejects ball mandrel.
- V. Telephone, data, and cable TV System Raceways 2-Inch Trade Size and Smaller: In addition to the above requirements, install in maximum lengths of 150 feet and with a maximum of three 90 degree bends or equivalent. Install pull or junction boxes where necessary to comply with these requirements.
- W. Install raceway sealing fittings according to the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL-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 where conduits enter or leave hazardous locations, where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces and air-conditioned spaces, and other places indicated on the drawings or required by the NEC.
- X. Stub-Up Connections: Use type of conduit described for stub ups from slab. Extend conduit through concrete floor for connection to freestanding equipment to a distance 6 inches above the floor and transition to Liquidtight flexible conduit. Provide grounding bushing at equipment end of Liquidtight flexible conduit. Connect equipment grounding conductor run with the serving branch circuit to this grounding bushing, the box, and the equipment ground connection point for the piece of equipment served.
- Y. Install conduit and provide sealant to preserve smoke partition using materials and methods under the provisions of Section 07 92 00 "Joint Sealants."
  - 1. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket.
- Z. Flexible Connections: Use maximum of 6 feet of flexible conduit for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use Liquidtight flexible conduit in wet or damp locations. Install separate ground conductor across flexible connections.
- AA. Surface Metal Raceway: Install a separate green ground conductor in raceway from the junction box supplying the raceway to receptacle or fixture ground terminals. Install surface metal raceway with all necessary offsets, fittings, bends and boxes to comprise a complete system.
  - 1. Select each surface metal raceway outlet box to which a lighting fixture is attached to be of sufficient diameter to provide a seat for the fixture canopy.
  - 2. Where a surface metal raceway is used to supply a fluorescent lighting fixture having central stem suspension with a backplate and a canopy (with or without extension ring), the backplate and canopy will serve as the outlet box and no separate outlet box need be provided.
  - 3. Provide surface metal raceway outlet box, in addition to the backplate and canopy, at the feed-in location of each fluorescent lighting fixture having end stem suspension.
  - 4. Where a surface metal raceway extension is made from an existing outlet box on which a lighting fixture is installed (provide a backplate slightly smaller than the fixture canopy), no additional surface mounted outlet box need be installed.

- BB. Set floor boxes level and adjust to floor surface.
- CC. Install hinged cover enclosures and cabinets plumb. Support at each corner.
- DD. Provide grounding connections for raceway, boxes, and components as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer's published torque-tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.
- EE. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.

### 3.4 BOXES AND CABINETS

- A. Provide boxes as shown and for splices, taps, wire pulling, equipment and fixture connections and where required by applicable codes and installation practices. Provide covers for all boxes.
- B. Electrical boxes are shown on drawings in approximate locations unless dimensioned. The Engineer or Architect shall be allowed to adjust the location of boxes up to 10 feet in any direction without additional cost to the project. This is intended for boxes for receptacles and switches and other wiring devices.
- C. Locate boxes to maintain headroom and present a neat appearance. Locate to allow proper access. Provide access doors for boxes located above inaccessible ceilings.
- D. Provide knockout closures to cap unused knockout holes where blanks have been removed.
- E. Support all boxes rigidly and independently of conduit except where specifically allowed by the National Electrical Code. Use supports suitable for the purpose.
- F. Set floor boxes level and adjust to floor surface.
- G. Outlet Boxes:
  - 1. Flush-mount outlet boxes in finished areas. Outlets in mechanical rooms, electrical rooms, and the above removable ceilings may be surface-mounted.
  - 2. Do not install boxes back-to-back in same wall. Provide at least 16 inch separation or greater where required by the building code. In hollow fire walls, maintain minimum 24 inch horizontal separation between outlets on opposite sides. Refer to detail 3, sheet E-8.01.
    - a. Masonry walls:
      - 1) Adjust position of outlets in finished masonry walls to suit masonry course lines where possible. Do not, however, violate maximum heights defined by accessibility codes such as ADA.
      - a) Coordinate cutting in of walls to achieve neat openings for boxes. Locate boxes in walls so that only the corner need be cut from masonry units where possible.
    - 2) Use multiple gang boxes where more than one device is mounted together. Provide barriers to separate different voltage systems.
    - 3) Ensure that thermal insulation will be in place behind outlet boxes before installing them in insulated walls. Do not damage insulation.

- 4) For outlets mounted above counters, benches, or backsplashes, coordinate location and mounting heights with architectural details. Install with bottom of box minimum 2 inches above backsplash.
  - 5) Adjust outlet mounting height and horizontal location to agree with required location for equipment served as may be shown on installation instructions or shop drawing for the equipment.
  - 6) Position outlets to locate luminaries as shown on reflected ceiling drawings. For recessed boxes in finished areas, secure to interior wall and partition studs; allow for surface finish thickness.
  - 7) Align wall-mounted outlet boxes for switches, thermostats, and similar devices.
- b. Pull and Junction Boxes:
- 1) Locate above accessible ceilings or in unfinished areas.
  - 2) Support independent of conduit.
  - 3) Locate pull or junction boxes to limit conduit runs to no more than 150 linear feet of four (4) 90 degree bends between pulling points. For telephone/ data limit bends to no more than three (3) 90 degree bends to pulling points.
- H. Special care shall be taken to set all flush boxes square and true with the building finish. The edge of the cover shall meet the building finish or be no greater than 1/8 inch back from the finish surface. All wall outlets shall be rigidly secured to the stud system, using adjustable supports where necessary, to prevent all box movement.

### **3.5 PROTECTION**

- A. Provide final protection and maintain conditions, in a manner acceptable to Engineer or Architect to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
- B. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
- C. Repair damage to PVC or paint finishes with matching touch-up coating recommended by the manufacturer.

### **3.6 CLEANING**

- A. Upon completion of installation of system, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

### **3.7 MARKING AND IDENTIFICATION**

- A. Mark and identify conduits in accordance with Section 26 05 53 "Identification for Electrical Systems."

### **3.8 RECORD DOCUMENTS**

- A. Accurately record actual routing of all feeder and sub-feeder conduits regardless of size and branch circuits conduits larger than 2 inches.

**END OF SECTION**

## **SECTION 26 05 53 - IDENTIFICATION**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes identification of electrical materials, equipment, and installations. It includes requirements for electrical identification components including but not limited to the following:
  - 1. Buried electrical line warnings
  - 2. Identification labeling for raceways, cables, and conductors
  - 3. Operational instruction signs
  - 4. Warning and caution signs
  - 5. Equipment labels and signs
- B. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

#### **1.2 SUBMITTALS**

- A. Do not submit product data or shop drawings. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. Electromark - Wolcott, New York
  - 2. Ideal Industries, Inc.
  - 3. 3M
  - 4. Panduit Corp.
  - 5. Seton Name Plate Co.
  - 6. Thomas & Betts
  - 7. W. H. Brady, Co. - Signmark Division - Milwaukee, Wisconsin

#### **2.2 ELECTRICAL IDENTIFICATION PRODUCTS**

- A. Indoor Pictogram Signs for Equipment and Doors to Electrical Equipment Rooms: Self adhesive, polyester, minimum 7 by 17 inch size.
- B. Wire and Cable Designation Tape Markers: Vinyl or vinyl-cloth, self-adhesive, wraparound, cable and conductor markers with preprinted numbers and letter.
- C. Plasticized Card Stock Tags: Vinyl cloth with preprinted and field-printed legends to suit the application. Orange background, except as otherwise indicated, with eyelet for fastener.

- D. Engraved, Plastic-Laminated Labels, Signs, and Instruction Plates: Engraving stock melamine plastic laminate, 1/16-inch minimum thick for signs up to 20 square inches, or 8 inches in length; 1/8-inch thick for larger sizes. Engraved legend in black letters on white face and punched for mechanical fasteners.
- E. Fasteners for Plastic-Laminated and Metal Signs: Self-tapping stainless steel screws or number 10-32 stainless steel machine screws with nuts and flat and lock washers.
- F. Cable Ties: Fungus-inert, self-extinguishing, nylon one-piece, self-locking cable ties, 0.18-inch minimum width, 50-lb minimum tensile strength, and suitable for a minimum temperature range from minus 50 deg F to 350 deg F. Provide ties in specified colors when used for color-coding.
- G. Identification Cable Ties: Same as "Cable Ties" above, except with integral tab of suitable size for marking requirements.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as required by code.
- B. All labels shall match the naming convention on the Campus one-line diagram.
- C. Emergency circuit labels shall be red background with white text: all other labels shall be black background with white text.
- D. All labels for switchgear, disconnects, MCCs, and panelboards shall be adhered engraved phenolic tags and identify where they are fed from (including panel identification and location)
- E. All labels on cables shall be cable wraps or zip-tied phenolic tags (as coordinated with the electric shop) and shall include "from" and "to" designators
- F. All junction boxes shall be labeled to identify the circuits.
- G. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.
- H. Apply identification to areas as follows:
  - 1. Clean surface of dust, loose material, and oily films before painting.
  - 2. Prime surfaces: For galvanized metal, use single-component acrylic vehicle coating formulated for galvanized surfaces. For concrete masonry units, use heavy-duty acrylic resin block filler. For concrete surfaces, use clear alkali-resistant alkyd binder-type sealer.
  - 3. Apply one intermediate and one finish coat of orange silicone alkyd enamel.
  - 4. Apply primer and finish materials in accordance with manufacturer's instructions.
- I. Identify Raceways of Certain Systems with Color Banding: Band exposed or accessible raceways of the following systems for identification. Bands shall be pretensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:
  - 1. Fire Alarm System: Red
  - 2. Telecommunications: Blue

- J. Identify Junction, Pull, and Connection Boxes: Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indicating system voltage in black, preprinted on orange background. Install on outside of box cover. Legibly mark box covers with identity of contained circuits with contrasting color permanent marker.
- K. Underground Electrical Line Identification: During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground line marking tape located 12" directly above each respective line.
- L. Conductor Color Coding for Conductors Rated 600 Volts and Less: See Specification Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."
- M. Tag or label conductors as follows:
  - 1. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.
- N. Apply warning, caution, and instruction signs and stencils as follows:
  - 1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items to which they connect. Install engraved plastic-laminated instruction signs with Owner approved legend where instructions or explanations are needed for system or equipment operation. Install fiberglass signs or outdoor items.
- O. Install identification as follows:
  - 1. Apply equipment identification nameplates of engraved plastic-laminate on each major unit of electrical equipment, including central or master unit of each electrical system. This includes communication, signal and alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), black lettering in white field. Text shall match terminology and numbering of the Contract Documents and shop drawings. All nameplates shall be mounted with rivets or screws. Apply labels for each unit of the following categories of electrical equipment.
    - a. Security monitoring master station or control panel
    - b. Fire alarm master station or control panel
    - c. Transformers
    - d. Electrical switchgear and switchboards
    - e. Motor starters, VFDs
    - f. Pushbutton stations
    - g. Contactors
    - h. Panelboards, electrical cabinets, and enclosures
    - i. Access doors and panels for concealed electrical items
- P. Apply labels of engraved plastic laminate for disconnect switches, circuit breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm and signal components, where labeling is specified elsewhere. For panelboards, provide framed, typed circuit schedules with explicit description and identification of items served by each individual switch and circuit breaker.
- Q. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- R. Nameplate Data: Provide permanent operational data nameplate on each item of power operated equipment, indicating manufacturer, product name, model number, serial number, capacity, operating and power

characteristics, labels of tested compliances, and similar essential data. Locate nameplates in an accessible location.

- S. Service Disconnects: Provide permanent engraved sign with 2 inch high black lettering on white background clearly describing the location of all other service disconnecting means (retail services for buildings 1A and 1B) when the building is served by more than one source of electrical power. Locate signs at each power source's disconnect means.
- T. Outdoor Electrical Equipment: Provide outdoor Pictogram type sign per above specifications, with the words "DANGER - HIGH VOLTAGE Hazardous Voltage. Will shock burn, or cause death. KEEP OUT." NEMA Mr. Ouch symbol shall be included. Install at all entrances to outdoor areas and every 20 feet along area fences, with at least one sign per side of fencing. Install on doors to equipment.
- U. Fusible Switches: Install fuse manufacturer supplied labels inside the door of the fusible switch indicating the proper type and fuse required for replacement.

**END OF SECTION**

## **SECTION 26 24 16 - PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes various types of fusible and circuit breaker panelboards and distribution panels.

#### **1.2 SUBMITTALS**

- A. Submittals for approval by the engineer are required for this section. Provide catalog cuts and descriptive literature. Provide schedule with bill of material indicating the following for each panel: bus material, ampere and voltage ratings, overcurrent device sizes, poles and type, including spares. Indicate spaces. Indicate all short circuit ratings.
- B. Provide two copies each of Product Data and Operation and Maintenance Data covering panelboards and panel board components to owner at completion of project.

#### **1.3 SUMMARY**

- A. This Section includes:
  - 1. Lighting and Appliance Panelboards
  - 2. Power Distribution Panelboards

#### **1.4 DELIVERY, STORAGE AND HANDLING**

- A. Delivery: Schedule delivery of panelboards so that they arrive at site no sooner than 3 weeks before installation.
- B. Storage: Store panelboards in clean, dry environment that is free of condensing humidity. Protect panelboards from dirt, water, construction debris and construction traffic, utilizing additional coverings if necessary. Maintain plastic wrapping until ready for installation. Provide temporary heat inside of panelboards if necessary to control humidity below condensing point. Provide and locate proper heat source so there is no possibility of heat damage or fire.
- C. Handling: Handle and move in accordance with panelboard manufacturer's printed recommendations. Handle and move in such a manner as to minimize stresses on panelboard and internal components and to avoid scratching of surfaces.

#### **1.5 QUALITY ASSURANCE**

- A. NEMA Standards: Comply with applicable NEMA standards, especially NEMA PB1, "Panelboards," NEMA PB1.1 "Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less," NEMA 250 "Enclosures," NEMA AB 1 - "Molded Case Circuit Breaker and Molded Case Switches" and NEMA KS 1 - "Enclosed Switches."
- B. UL Standards: Comply with applicable UL standards, especially UL 67 - "Electric Panelboards," and UL 50 - "Boxes and Cabinets," UL 98 - Enclosed and Deadfront Switches" and UL 489 - "Molded Case Circuit Breakers and Circuit Breaker Enclosures." Comply with UL 869, UL 486A, UL 486B and UL 1053 for components and enclosures.



- C. Federal Specifications: Comply with applicable Federal Specifications, especially W-C-375B/GEN - "Molded Case Circuit Breakers," W-C-865C - "Fusible Switches," W-P-115B Type I Class 1 and W-P-115B Type II Class 1.
- D. Warranty: Panelboard and components shall be warranted to be free from manufacturing defects for a period of one year after project acceptance by owner.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. GE Electrical Distribution & Control.
  2. Square D; Schneider Electric.
  3. Eaton; Cutler-Hammer

**2.2 PANELBOARDS, GENERAL REQUIREMENTS**

- A. Enclosures: Dead front cabinets, flush or surface mounted as indicated. Unless otherwise indicated, provide the following NEMA enclosure types per the indicated locations:

Location	NEMA Type
Dry, clean indoor	NEMA 1
Outdoor or Damp or wet interior locations	NEMA 3R
Indoor or outdoor corrosive areas or areas subjected to hose streams	NEMA 4X
Dusty indoor areas	NEMA 12

- B. Front: Secured to box with concealed trim clamps except as indicated. Front for surface-mounted panels shall be same dimensions as box. Fronts for flush panels shall overlap box.
- C. Directory Frame: Metal, mounted inside each panel door.
- D. Factory Nameplates and Labeling: Provide metal nameplate containing system information, catalog number and factory order number. Nameplate shall be secured to the dead-front with rivets or screws. Interior wiring diagram, neutral wiring diagram, UL listing number and short circuit current rating labels shall be permanently affixed to the interior.
- E. Main, Neutral and Ground Buses: Hard drawn copper of 98 percent conductivity. Horizontal bussing shall be fully rated, non-tapered, extended, drilled and tapped for extension to future sections without modifying the bus. Vertical bussing in each section shall be non-tapered, extended, drilled and tapped to accommodate all future devices presently indicated as spaces, without modifying the bus. Neutral bus to be rated at 100 per cent of the main bus rating. Ground bus to be rated minimum 25% per cent of the main bus rating.
- F. Equipment Ground Bus: Adequate for panelboard feeder and branch-circuit equipment ground conductors. Equipment ground bus shall be large enough and have sufficient quantity and sizes of terminations to allow for termination of panelboard feeder plus one equipment grounding conductor per circuit, based on the maximum number of branch circuit protective devices allowed in the panelboard plus 6 additional conductors. Increase terminations to accommodate additional feeder conductors where double lugged panelboards are indicated. When panelboards are multiple section, provide equipment ground busses in each section of sufficient size for all grounding conductors in that section. Ground busses to be insulated from the

panelboard enclosure where isolated ground busses are called for; ground busses shall be bonded to enclosure when isolated ground busses are not called for.

- G. Circuit Breakers for Switching Lights at Panelboards: Type SWD Circuit Breakers where lighting circuits are switched by the respective branch circuit at the panelboard and type HACR circuit breakers where HVAC loads are served by the respective branch circuit.
- H. Ground Fault Circuit Interrupter Circuit Breakers: Unless noted otherwise, GFCI circuit breakers are to be UL Class A, intended for operation on circuits of 240 volts or less and tripping at no more than 6 mA of ground fault current.
- I. Main, Neutral, and Ground Lugs and Buses: Provide mechanical connectors for conductors. Provide necessary additional wire bending and terminating space when sub-feed lugs are called for.

### 2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

- A. Interiors: Provide physical means to prevent installation of more OCPDs than the quantity for which the enclosure was listed. Interiors shall be field convertible for top or bottom feed.
- B. Branch OCPDs: Molded case, thermal magnetic, trip-free circuit breakers. Provide only bolt-on circuit breakers, replaceable without disturbing adjacent units. Circuit breaker escutcheon shall have "ON" and "OFF" markings. Circuit breaker handle accessories shall provide provisions for locking handle in the "ON" or "OFF" position. Circuit breaker faceplate and handle shall indicate rated ampacity. Circuit breaker faceplate shall indicate UL certification standards with applicable voltage systems and corresponding AIC ratings. Tandem circuit breakers shall not be used. Multi-pole circuit breakers shall have common trip. Circuit breakers 30 amperes and less shall be UL listed to accept copper conductors with insulation rated at 60 75 and 90 degrees Celsius, with conductors sized from the 60 degree Celsius column of Table 310-16 of the NEC. Circuit breakers larger than 30 amperes shall be UL listed to accept copper conductors with insulation rated at 75 or 90 degrees Celsius with conductors sized from the 75 degree Celsius column of Table 310-16 of the NEC.
- C. Provide panelboards with quantity of overcurrent devices (poles) in one cabinet as indicated on "Schedule(s) of Panelboards" shown on one-line diagrams.
- D. Box: Box shall be nominally 5-3/4 inches deep by 20 inches wide.
- E. Circuit Numbering: Provide factory fabricated circuit numbers adjacent to each circuit breaker pole position. Numbering shall be continuous from top most pole position to last possible pole position. Number sequence on left shall be 1-3-5-7, etc., and number sequence on right shall be 2-4-6-8, etc. Numbering material shall be insert or strip type, as manufactured by the panelboard manufacturer for the specific panelboard. Adhesive markers and pen type markers are not acceptable.
- F. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.
- G. Short Circuit Rating: Unless a higher value is indicated in the panelboard schedules on the drawings, the minimum short circuit rating of the panelboard and each individual circuit breaker shall be 22,000 amperes symmetrical for 480/277V panelboards and 10,000 amperes for 208Y/120V panelboards, unless a greater amount is listed on the one-line diagram on drawing E400. Series rated panelboards will not be allowed. All panelboards shall be fully rated.

### 2.4 IDENTIFICATION

- A. General: Refer to Section 26 19 50 "Identification for Electrical System" for labeling materials.

- B. Panelboard Nameplates: Engraved laminated plastic or metal nameplate for each panelboard shall be mounted with rivets or screws.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. General: Install panelboards and accessory items in accordance with NEMA PB 1.1, "General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less" and manufacturers' written installation instructions.
- B. Mounting Heights: Top of trim 6-feet 2-inches above finished floor, except as indicated. Align top edges of panelboard covers where multiple panelboards are installed in the same general area.
- C. Mounting: Plumb and rigid without distortion of box. Mount flush panels uniformly flush with wall finish.
- D. Circuit Directory: Typed and reflective of final circuit changes.
- E. Fuse labels: Install pre-printed label from fuse manufacturer inside the cover of each fusible switch indicating the proper replacement fuse.
- F. Install filler plates in unused spaces.
- G. Provision for Future Circuits at Flush Panelboards: Stub two 1-inch empty conduits from panel into accessible ceiling space or space designated to be ceiling space in future.
- H. Auxiliary Gutter: Install where a panel is tapped to a riser at an intermediate location.
- I. Wiring in Panel Gutters: Train conductors neatly in groups, bundle, and wrap with wire ties.

#### **3.2 IDENTIFICATION**

- A. Identify field-installed wiring and components and provide warning signs in accordance with Division 26 Section "Identification for Electrical Systems."

#### **3.3 GROUNDING**

- A. Connections: Make equipment grounding connections for panelboards as indicated.
- B. Provide ground continuity to main electrical ground bus indicated.

#### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals, including grounding connections, in accordance with manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

#### **3.5 FIELD QUALITY CONTROL**

- A. Pre-testing: Upon completing installation of the system, perform the following tests:
  - 1. Make insulation resistance tests of panelboard buses, components, and connecting supply, feeder, and control circuits.

2. Make continuity tests of circuits.
- B. Quality Control Program: Conform to the following:
1. Procedures: Make field tests and inspections and prepare panelboard for satisfactory operation in accordance with manufacturer's recommendations and these specifications.
  2. Schedule tests with at least one week in advance notification.
- C. Visual and Mechanical Inspection: Include the following inspections and related work:
1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
  2. Exercise and perform operational tests of all mechanical components and other operable devices in accordance with manufacturer's instruction manual.
  3. Check panelboard mounting, area clearances, alignment and fit of components.
  4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
- D. Electrical tests: Include the following items performed in accordance with manufacturer's instruction:
1. Insulation resistance test of buses and portions of control wiring that disconnected from solid-state devices. Insulation resistance less than 100 megohms is not acceptable.
  2. Ground resistance test on system and equipment ground connections.
- E. Retest: Correct deficiencies identified by tests and observations and provide re-testing of panelboards by testing organization. Verify by the system tests that the total assembly meets specified requirements.

**3.6 CLEANING**

- A. Upon completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots, dirt, and debris. Touch up scratches and mars of finish to match original finish.

**END OF SECTION**

## SECTION [26 27 13.13][16295]

### POWER AND ENERGY METERS

#### PowerLogic™ Meters and Related Devices by Schneider Electric

##### Schneider Electric Editor's Note:

This guide specification is written in accordance with the Construction Specifications Institute (CSI) Master Format. This section must be carefully reviewed and edited by the architect or the engineer to meet the requirements of the project. Coordinate this section with other specification sections within the Contract Documents and Drawings.

To properly use / edit this document, show formatting and hidden text by selecting ¶ on the menu or by typing (Ctrl+\*) simultaneously. Except for these introductory and closing paragraphs, green hidden text will not print. Text in red is optional. Red text in [brackets] denotes multiple options where one or more should be chosen. All red text should be edited and changed to black for final project conformation. In addition, these introductory paragraphs should be deleted or changed to hidden text.

**This specification may be used in whole or in part. It is intended that this document specify subcomponent products to be referenced by other specification sections or drawings for the furnishing of completed assemblies or systems. The Part 2 – Product subsections may also be copied into other specification sections in lieu of including this specification section in the Contract Documents.**

#### PART 1 - GENERAL

##### 1.1 SUMMARY

- A. Scope: Provide labor, material, equipment, related services, and supervision required, including, but not limited to, manufacturing, fabrication, configuration and installation for power and energy meters as required for the complete performance of the work, as shown on the drawings, as specified herein, and as specified elsewhere for the assemblies or systems comprised of the components specified herein.
- B. Related Sections: Related sections include, but shall not be limited to, the following:
  - 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  - 2. Applicable general requirements for electrical Work specified within Division 26 Specification Sections apply to this Section.
  - 3. Refer to specification Section 26 09 13 Electrical Power Management System for additional requirements.
  - 4. Electrical Power Management System

##### 1.2 REFERENCES

- A. General, Publications: The publications listed below form a part of this Specification to the extent referenced. The publications are referred to in the text by the basic designation only. The edition/revision of the referenced PUBLICATIONS shall be the latest date as of the date of the Contract Documents, unless otherwise specified.
  - 1. American National Standards Institute (ANSI)
    - a. ANSI C12.20, "Electricity Meters - 0.2 and 0.5 Accuracy Classes"
    - b. ANSI C12.18, "Protocol Specification for ANSI Type 2 Optical Port"
  - 2. Canadian Standards Association (CSA)

- a. CAN/CSA-C22.2 No. 61010-1 “Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use - Part 1: General Requirements”
- b. C22.1, “Canadian Electrical Code, Part I” (CEC)
- 3. International Electrotechnical Commission (IEC)
  - a. IEC 62053-22 Class 0.5, “Electricity metering equipment (a.c.) - Particular requirements - Part 21: Static meters for active energy (classes 0.2 and 0.5) Edition 1.1 2016-11”
- 4. European Engineering Standards (CSN EN)
  - a. EN 61000-6-2, “Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity for industrial environments”
  - b. EN 61000-6-3 Class B, “Electromagnetic compatibility (EMC) - Part 6-3: Generic standards – “Emission standard for residential, commercial and light-industrial environments”
  - c. EN 61000-6-4 Class A, “Electromagnetic compatibility (EMC) - Part 6: Generic Standards - Emission standard for industrial environments”
  - d. EN 61010-1, “Safety requirements for electrical equipment for measurement, control, and laboratory use - Part 1: General requirements”
  - e. EN 61326-1 Class A, Electrical equipment for measurement, control and laboratory use EMC requirements Part 1: General requirements
  - f. EN 61326-1 Class B, Electrical equipment for measurement, control and laboratory use EMC requirements Part 1: General requirements, (Residential and light industrial)
- 5. International Organization for Standardization (ISO)
  - a. ISO 9001, “Quality Management Systems - Requirements”
  - b. ISO 14001, “Environmental Management Systems - Requirements with Guidance for Use”
  - c. ISO 14062, “Environmental Management - Integrating Environmental Aspects into Product Design and Development”
  - d. ISO 50001:2011 “Energy management systems”
- 6. National Fire Protection Agency (NFPA)
  - a. NFPA 70, “National Electrical Code® (NEC)”
- 7. Underwriters Laboratories, Inc. (UL):
  - a. UL 61010, “Electrical Equipment for Measurement, Control, and Laboratory Use”
  - b. UL 61010-1, “Safety Requirements for Electrical Equipment for Measurement, Control, and Laboratory Use; Part 1: General Requirements”
  - c. UL 508, “Standard for Industrial Control Equipment”
  - d. UL508A, “Standard for Industrial Control Panels”
- 8. USA Federal Communications Commission (FCC)
  - a. FCC 47 CFR Part 15 Class A, "Radio Frequency Devices"
  - b. FCC 47 CFR Part 15 Class B, "Radio Frequency Devices"

### 1.3 DEFINITIONS

- A. Unless specifically defined within the Contract Documents, the words or acronyms contained within this specification shall be as defined within, or by the references listed within this specification, the Contract Documents, or, if not listed by either, by common industry practice.

### 1.4 SUBMITTALS

- A. General: Submittals shall be in accordance with the requirements of Section [01 33 00][01300] Submittals and Section [26 00 10][16010] Electrical Requirements, in addition to those specified herein.

- 1. **Submit sufficient information to determine compliance with the Contract Documents. Identify submittal data with the specific equipment tags and/or service descriptions to which they pertain.**

Submittal data shall be clearly marked to identify the specific model numbers, options, and features of equipment and work proposed.

2. Deviations from the Contract Documents shall be indicated within the submittal. Each deviation shall reference the corresponding drawing or specification number, show the Contract Document requirement text and/or illustration, and shall be accompanied by a detailed written justification for the deviation.

## 1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Manufacturer shall be a firm engaged in the manufacture of specified products of types and sizes required, and whose products have been in satisfactory use in similar service for a minimum of ten years.
  1. The manufacturer shall have a valid ISO 9001 certification and an applicable quality assurance system that is regularly reviewed and audited by a third-party registrar. Manufacturing, inspection, and testing procedures shall be developed and controlled under the guidelines of the quality assurance system.
  2. The manufacturer or their representative shall have service, repair, and technical support services available 24 hours 7 days a week basis.
- B. All work performed and all materials used shall be in accordance with the National Electrical Code, and with applicable local regulations and ordinances. Process controllers, assemblies, materials, and equipment shall be listed and labeled by Underwriter's Laboratories or by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## 1.6 DELIVERY, STORAGE AND HANDLING

- A. Prior to delivery to the Project site, ensure that suitable storage space is available to store materials in a well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres. Materials shall be protected during delivery and storage and shall not exceed the manufacturer stated storage requirements. As a minimum, store indoors in clean, dry space with uniform temperature to prevent condensation. In addition, protect electronics from all forms of electrical and magnetic energy that could reasonably cause damage.
- B. Deliver materials to the Project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified within the Contract Documents.
- C. Inspect and report any concealed damage or violation of delivery storage, and handling requirements to the Engineer.

## 1.7 WARRANTY

- A. General: Refer to [\[Section 01 77 00 - Closeout Procedures\]](#) [\[Section 01770 - Closeout Procedures\]](#).
- B. Additional Owner Rights: The warranty shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.



## PART 2 - PRODUCTS

### 2.1 GENERAL REQUIREMENTS

- A. Products specified herein shall be the product of a single manufacturer. Products and manufacturers specified are to establish a standard of quality for design, function, materials, and appearance. Products shall be modified as necessary by the manufacturer for compliance with requirements.
- B. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date:
1. Square D PowerLogic by Schneider Electric
  2. [2<sup>nd</sup> manufacturer]
  3. [3<sup>rd</sup> manufacturer]

### 2.2 POWER METERS [NOT USED]

- A. Provide the following specified product and manufacturer without exception, unless approved as a substitute by addendum to the Contract Documents prior to the bid date: PowerLogic PM5000 series by Schneider Electric, [2<sup>nd</sup> manufacturer] or [3<sup>rd</sup> manufacturer].
- B. The metering device used to monitor circuits for purposes of network management, energy cost management, energy allocation, and operational efficiency shall provide the following minimum features:
1. Connections and form factor - direct connect to circuits up to 600 VAC, eliminating the need for voltage (potential) transformers; 5 A nominal current inputs; control power voltage range option of 100-480VAC/125-250VDC. Meter shall have removable connectors required for voltage inputs, control power, communications, aux. inputs and outputs; easy mounting in enclosure panel/door without tools; form factor of ¼ DIN size with 92 X 92mm cut-out and 96 x 96mm panel mount integrated display.
  2. Supported monitoring parameters—full range of 3-phase voltage, measure each phase and neutral current using 4 current inputs, power and energy measurements, power factor, frequency, total harmonic distortion (THD), individual power harmonics (up to 63<sup>rd</sup> order).
  3. Accuracy standards - use four-quadrant metering and sample current/voltage simultaneously without gaps with 64 samples per cycle (zero blind); comply with ANSI C12.20 class 0.2 and IEC 61557-12 class 0.2 for revenue meters.
  4. Display - Backlit dot-matrix LCD display, anti-glare and scratch resistant with a minimum of 128 x128 pixels, capable of displaying four values in one screen simultaneously; a summary screen to allow the user to view a snapshot of the system; support either integrated or remote display.
  5. Support 4 digital inputs for Demand Synch Pulse, Time Synch Input, and Conditional Energy Control; have 2 digital outputs that operate either by user command sent over communication link, or in response to a user defined alarm or event.
  6. Communications - serial RS-485 Modbus, Ethernet Modbus TCP, Ethernet BACnet IP (BTL listed), DNP over Ethernet, and EtherNet IP; provide 2 Ethernet ports to allow wiring from meter to meter as a daisy-chain; be capable of serving data over the Ethernet network accessible through a standard web browser; the monitor shall contain default pages from the factory.
  7. Onboard data logging capabilities - to log data, alarms and events; logged information shall include data logs, minimum/maximum log files of selected parameter values, and alarm logs for each user defined alarm or event log; support the following on-board nonvolatile memory—14 parameters every 15 minutes for 90 days.
  8. Alarming capabilities - support 29 set-point driven alarms, 4 digital alarms, 4 unary alarms, 10 Boolean alarms and 5 custom alarms; user definable alarm events; set-point driven alarms shall be available for voltage/current parameters, input status, and end of interval status; shall send

emails and/or text messages containing alarm condition indication via Simple Mail Transfer Protocol [SMTP]; Shall have the capability to manage and monitor devices on the IP network via Simple Network Management Protocol [SNMP]; Indication of an alarm condition shall be delivered by SNMP Traps.

9. Firmware-upgradeable to enhance functionality through the Ethernet or serial communication connection and shall allow upgrades of individual meters or groups.
10. Integrated gateway functionality, enabling the capability to connect via Ethernet to downstream, serially connected devices.
11. Designed accordingly to eco-design complying with ISO 14062, especially MCCB materials shall be halogen free type; designed for easy disassembly and recycling at end of life and comply with environmental directives ROHS and WEEE.
12. The meter shall provide 4 digital inputs configurable for input metering with on-board pulse weight calculation and conversion to standard units for external water, air, gas, electrical or steam (WAGES) meters.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. In addition to the requirements specified herein, execution shall be in accordance with the requirements of Specification Section [26 00 10][16010] and Drawings.
- B. Examine equipment exterior and interior prior to installation. Report any damage and do not install any equipment that is structurally, moisture, or mildew damaged.
- C. Verification of Conditions: Examine areas and conditions under which the work is to be installed, and notify the Contractor in writing, with a copy to the Owner and the Engineer, of any conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected.
- D. Beginning of the work shall indicate acceptance of the areas and conditions as satisfactory by the Installer.
- E. Install equipment in accordance with reviewed product data, final shop drawings, manufacturer's written instructions and recommendations, and as indicated on the Drawings.
- F. Functional testing, commissioning, and first parameter adjusting shall be carried out by a factory trained manufacturer's representative field service engineer. Test and adjust controls and safeties. Replace damaged or malfunctioning controls and equipment. Report to the Engineer any discrepancies or issues with the installation.
- G. Provide final protection and maintain conditions in a manner acceptable to the manufacturer that shall help ensure that the equipment is without damage at time of Substantial Completion.

### END OF SECTION [26 27 13.13][16295]

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## **SECTION 26 27 26 - WIRING DEVICES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes various types of receptacles, connectors, switches, and finish plates.

#### **1.2 SUBMITTALS**

- A. Submittals for approval by the engineer are required for this section. Provide catalog cuts and descriptive literature.
  - 1. Sample: Submit sample of receptacle plate or switch plate.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with NFPA 70 - "National Electrical Code" for devices and installation.
- B. Comply with UL 498 - "Attachment Plugs and Receptacles."
- C. Comply with UL 943 - "Ground-Fault Circuit-Interrupters."
- D. Listing and Labeling: Provide products which are listed and labeled by Underwriter's Laboratories for their applications and installation conditions and for the environments in which installed.

#### **1.4 COORDINATION**

- A. Wiring Devices for Owner-Furnished Equipment: Match devices to plug connectors for Owner-furnished equipment.
- B. Cord and Plug Sets: Match cord and plug sets to equipment requirements.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Wiring Devices:
    - a. Arrow Hart Div., Cooper Industries
    - b. Leviton
    - c. Hubbell Inc.
    - d. Bryant
    - e. Pass & Seymour/Legrand
  - 2. Multi-Outlet Assemblies:
    - a. Wiremold 2400 series.
  - 3. Vacancy Sensors:
    - a. Watt-Stopper
    - b. Sensor Switch
    - c. Leviton
    - d. Lutron
    - e. Hubbell
  - 4. Poke-Through, Floor Service Outlets, and Telephone/Power Poles:

- a. Hubbell, Inc.
- b. Wiremold Co.
- 5. Device Enclosures for Outdoor and Other Wet and Damp Locations:
  - a. Pass & Seymour
  - b. Thomas & Betts
  - c. Leviton, Inc.
  - d. Hubbell

**2.2 WIRING DEVICES**

- A. Comply with NEMA Standard WD 1, "General Purpose Wiring Devices" and NEMA Standard WD6 "Wiring Device Dimensional Requirements."
- B. Enclosures: NEMA 1 equivalent, except as otherwise indicated.
- C. Color: Ivory except as otherwise indicated or required.
- D. Receptacles, Straight-Blade and Locking Type: Except as otherwise indicated, comply with UL Standard 498, "Electrical Attachment Plugs and Receptacles." Provide UL labeling of devices to verify these compliances. Provide straight blade receptacles per table on the following page.
- E. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, UL 498, UL 1449, IEEE 587 and Federal Spec W-C 596.
  - 1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper.
    - b. Hubbell.
    - c. Leviton.
    - d. Pass & Seymour; (reference standard: TR5362).

STRAIGHT BLADE DUPLEX RECEPTACLES						
APPLICATION	SPECIFICATION	ARROW HART	BRYANT	HUBBELL	LEVITON	PASS & SEYMOUR
Specification Grade	UL 498, Fed Spec. WC 596	*	*	HBL5362	*	*
Heavy Duty GFI	UL 943, UL 498, Fed. Spec. WC 596G	*	*	GF20	*	*

Duplex, straight blade devices, 120 volt, 20 amperes. All shall comply with Federal Specification W-C-596, NEMA configuration 5-20R.

\*See reference standard.

- F. Locking or special type to be of NEMA configuration called out for the specific application on the drawings.
- G. Cord and Plug Sets: Match voltage and current ratings and number of conductors to requirements of the equipment being connected.
  - 1. Cord: Rubber-insulated, stranded copper conductors, with type SOW-A jacket. Grounding conductor shall have green insulation. Minimum ampacity of cord shall be equipment rating plus 25 percent minimum.
  - 2. Plug: Male configuration with nylon body and integral cable-clamping jaws. Match to cord and to receptacle type intended for connection.
- H. Snap Switches: Quiet-type A.C. switches, Underwriter's Laboratories listed and labeled as complying with UL Standard 20 "General Use Snap Switches, 20A, 277v.
- I. Cover Plates for Interior Wiring Devices: Single and combination types that mate and match with corresponding wiring devices. Features include the following:
  - 1. Color/material: Stainless steel with brushed nickel satin finish
- J. Device Enclosures for Outdoor and Other Wet and Damp Locations: Enclosure shall be suitable for wet locations while in use in accordance with Article 410-57 (b) and listed and labeled for the specific use by Underwriter's Laboratories. Enclosure shall be clearly and visibly marked by the factory with the wording "Suitable For Wet Locations While In Use." Enclosure shall be non-metallic with hinged clear cover and integral key operated cover lock. Cover to have two exit holes for up to 3/8 inch diameter cords with holes located at bottom of cover. Provide cover with device opening matched to type of wiring device used - e.g., duplex receptacle, GFCI receptacle, and toggle switch.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install devices and assemblies plumb and secure.
- B. Install wall plates when painting is complete.
- C. Arrangement of Devices: Except as otherwise indicated, mount flush, with long dimension vertical, and grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- D. Protect devices and assemblies during painting.
- E. Adjust locations at which floor service outlets and telephone and power service poles are installed to suit the indicated arrangement of partitions and furnishings.

#### **3.2 IDENTIFICATION**

- A. Comply with Division 26 Section "Identification for Electrical Systems."
  - 1. Switches: Where 3 or more switches are ganged, and elsewhere where indicated, identify each switch with approved legend engraved on wall plate.
  - 2. Receptacles: Identify the panelboard and circuit number from which served. Mark on inside face of coverplate.

#### **3.3 FIELD QUALITY CONTROL**

- A. Testing: Test wiring devices for proper polarity and ground continuity. Operate each operable device at least 6 times.

- B. Test ground-fault circuit interrupter operation according to manufacturer recommendations.
- C. Replace damaged or defective components.

**3.4 CLEANING**

- A. General: Internally clean devices, device outlet boxes, and enclosures. Replace stained or improperly painted wall plates or devices.

**END OF SECTION**

## **SECTION 26 28 13 - FUSES**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes the following:
  - 1. Cartridge fuses rated 600-V ac and less for use in control circuits, enclosed switches, switchboards, and enclosed controllers.
  - 2. Spare fuse cabinet.

#### **1.2 SUBMITTALS**

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.

#### **1.3 QUALITY ASSURANCE**

- A. Comply with NFPA 70 "National Electrical Code" for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled by Underwriter's Laboratories for the specific use and purpose.
- C. Single-Source Responsibility: All fuses shall be the product of a single manufacturer.

#### **1.4 EXTRA MATERIALS**

- A. Furnish the following extra materials that match products installed, packaged with protective covering for storage, and with identification labels clearly describing contents.
  - 1. Spare Fuses: Furnish quantity equal to at least one set of each size and installed in the project. Store in spare fuse cabinet.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide fuses by Bussmann Div., Gould-Shawmut

#### **2.2 CARTRIDGE FUSES**

- A. Characteristics: NEMA FU 1 nonrenewable cartridge fuse, class as specified or indicated, current rating as indicated, voltage rating consistent with circuit voltage.
- B. Cartridge Fuses: Cartridge fuses shall be as described below and shall have a minimum interrupting rating of 200,000 symmetrical amperes for the AC voltage at which they are rated.
  - 1. Fuses rated 600 amperes and less:
- C. Unless specifically shown otherwise on the drawings, provide the following classes of fuses:



1. Branch circuit fuses, such as motor fuses, where the fuse is the final overcurrent device in the circuit: UL class RK-1 dual element time delay fuses.
2. Feeder fuses, such as for panelboards, where the fuse supplies a downstream circuit breaker or other UL Class RK-1 fuse: UL Class RK-1 dual element time delay fuses, unless otherwise noted.
3. Feeder fuses where the fuse supplies only another UL Class RK-1 fuse: UL Class RK-1 dual element time-delay fuses.

D. The following table lists the Bussmann fuses to be used for each UL Class.

Voltage	Class L	Class RK-1
600	KRP-C	LPS-RK
240	KRP-C	LPN-RK

E. Control Circuit Fuses: Provide Bussmann type KTK-R fast acting, rejection type, current-limiting fuses for control circuit protection.

### 2.3 SPARE FUSE CABINET

- A. Cabinet: Wall-mounted, 18-gage minimum steel unit with full-length, recessed piano-hinged door with key-coded cam lock and pull. Provide one cabinet per building, located in the main electrical room of each building.
- B. Size: Adequate for orderly storage of spare fuses specified with 15 percent spare capacity minimum.
- C. Finish: Gray baked enamel.
- D. Identification: Stencil legend "SPARE FUSES" in 1-1/2-inch letters on door.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Install fuses in fusible devices as indicated. Arrange fuses so that fuse ratings are readable without removing fuse.
- B. Fuses shall not be installed in equipment before the equipment has been set and anchored in its final position at the project site.
- C. Install spare fuse cabinet where indicated.

### 3.2 IDENTIFICATION

- A. Install pre-printed labels from fuse manufacturer on the inside door of each fused switch to indicate exact fuse type and size for replacement information.

**END OF SECTION**

## **SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS**

### **PART 1 - GENERAL**

#### **1.1 SUMMARY**

- A. This Section includes circuit and motor disconnects.

#### **1.2 SUBMITTALS**

- A. Submittals for approval by the Engineer are not required for this section. Unrequested submittals will not be processed or reviewed. Non-requirement of submittals is not to be construed as an allowance for substitutions and does not relieve the contractor from full compliance with the plans and specifications.
- B. Submit the following to the owner at the completion of the project in accordance with Conditions of Contract and Division 01 Specification Sections.
  - 1. Product data for products specified in this Section: Include dimensions, ratings, and data on features and components.
  - 2. Maintenance data for products for inclusion in Operating and Maintenance Manual specified in Division 01 and in Division 26 Section "Common Work Results for Electrical Systems."

#### **1.3 QUALITY ASSURANCE**

- A. Electrical Component Standards: Provide components complying with NFPA 70 "National Electrical Code" and which are listed and labeled by UL. Comply with UL Standard 98 and NEMA Standard KS 1.
- B. All switches 600 amperes and smaller shall be of the same manufacturer; switches larger than 600 amperes shall also be products of one manufacturer, although not necessarily the same manufacturer as switches rated 600 amperes and smaller.

### **PART 2 - PRODUCTS**

#### **2.1 MANUFACTURERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D Company
  - 2. Eaton Cutler Hammer

#### **2.2 CIRCUIT AND MOTOR DISCONNECT SWITCHES**

- A. General: Provide circuit and motor disconnect switches in types, sizes, duties, features, ratings, and enclosures as indicated. Provide NEMA 1 enclosure except for outdoor switches, and other indicated locations. Outdoor circuit and motor disconnects shall be NEMA 3R enclosures, unless otherwise indicated, and shall be provided with raintight hubs. For motor and motor starter disconnects, provide units with horsepower ratings suitable to the loads.
- B. Switches: Heavy duty, quick make, quick break switches, surface mounted unless otherwise noted, of classes and current ratings indicated. Unless indicated otherwise, provide 3 blade, with solid neutral when a neutral is provided.
- C. Fusible switches 800A and 1200A may be as described above or may be high pressure contact type.

- D. Switches 1600A and above shall be high pressure contact type. Bolted pressure switches are not allowed.
- E. Switches for elevators shall include auxiliary contacts for switch position, locking hasp, shunt-trip activation, shunt-trip circuit monitoring relay. Bussmann Power Module.
- F. Provide positive pressure, reinforced type Class R fuse clips for fusible switches 600 amps or less to prevent other than UL Class RK current limiting fuses. Provide for class L fuses for switches over 600A.
- G. Switches shall have provisions for padlocking the enclosure in the closed position and another provision for padlocking the switch operator in the open and closed positions. It shall not be possible to open the switch enclosure with the switch operator in the closed position, except by means of a defeat mechanism located to be found by experienced and knowledgeable personnel only. The defeat mechanism shall not be obvious to an untrained person.
  - 1. Lugs: Provide mechanical lugs and power-distribution connectors for number, size, and material of conductors indicated.
- H. Service Switches: Shall be as above, but shall also be UL listed for use as service equipment under UL Standard 98 or 869.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Install enclosed switches and circuit breakers in locations as indicated, according to manufacturer's written instructions.
- B. Install disconnect switches for use as local disconnect switches with motor driven equipment within sight of the associated equipment.
- C. Install enclosed switches and circuit breakers level and plumb.
- D. Install wiring between enclosed switches and circuit breakers and control and indication devices.
- E. Connect enclosed switches and circuit breakers and components to wiring system and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts according to equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL Standard 486A.

#### **3.2 NAMEPLATES**

- A. Provide a nameplate conforming with Section 260553 "Identification for Electrical Systems" on every disconnect defining what the load that it serves or disconnects.

#### **3.3 FIELD QUALITY CONTROL**

- A. Testing: Subsequent to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening and closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

**3.4 CLEANING**

- A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish including chips, scratches, and abrasions.

**END OF SECTION**

OHIO UNIVERSITY  
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CONSTRUCTION DOCUMENTS  
SEPTEMBER 9, 2024  
OU PROJECT 23002

## **SECTION 28 46 21 - ADDRESSABLE FIRE-ALARM SYSTEMS**

### **GENERAL**

#### **1.01 RELATED DOCUMENTS**

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

#### **1.02 SUMMARY**

- A. Section Includes:
  - 1. Fire-alarm control unit.
  - 2. System smoke detectors.
  - 3. Addressable interface device.
  - 4. Network communications.

#### **1.03 DEFINITIONS**

- A. EMT: Electrical Metallic Tubing.
- B. FACP: Fire Alarm Control Panel.
- C. HLI: High Level Interface.
- D. NICET: National Institute for Certification in Engineering Technologies.

#### **1.04 ACTION SUBMITTALS**

- A. Product Data: For each type of product, including furnished options and accessories.
  - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
  - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- B. Shop Drawings: For fire-alarm system.
  - 1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - 2. Include plans, elevations, sections, details, and attachments to other work. Update existing drawings on record for building to reflect system upgrade, added devices on Ground Floor, and any devices to be removed from areas of scope.
  - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
  - 4. Detail assembly and support requirements.
  - 5. Include voltage drop calculations for notification-appliance circuits.
  - 6. Include battery-size calculations.
  - 7. Include input/output matrix.

8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
  9. Include performance parameters and installation details for each detector.
  10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
  11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
  12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
    - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
    - b. Show field wiring required for HVAC unit shutdown on alarm.
    - c. Locate detectors according to manufacturer's written recommendations.
  13. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- C. General Submittal Requirements:
1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Engineer.
  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 IV minimum.
    - c. Licensed or certified by authorities having jurisdiction.
- E. Delegated-Design Submittal: For notification appliances and duct smoke detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1. Drawings showing the location of each notification appliance and duct smoke detector, ratings of each, and installation details as needed to comply with listing conditions of the device.
  2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
  3. Indicate audible appliances required to produce square wave signal per NFPA 72.

## **1.05 INFORMATIONAL SUBMITTALS**

A. Qualification Data: For Installer.

B. Field quality-control reports.

## **1.06 Sample Warranty: For special warranty.**

## **1.07 CLOSEOUT SUBMITTALS**

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to authorities having jurisdiction:
  - a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  - b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
  - c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.
  - d. Riser diagram.
  - e. Device addresses.
  - f. Record copy of site-specific software.
  - g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
    - 1) Equipment tested.
    - 2) Frequency of testing of installed components.
    - 3) Frequency of inspection of installed components.
    - 4) Requirements and recommendations related to results of maintenance.
    - 5) Manufacturer's user training manuals.
  - h. Manufacturer's required maintenance related to system warranty requirements.
  - i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

**B. 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.

**1.08 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. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
  2. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
  3. Keys and Tools: One extra set for access to locked or tamperproofed components.
  4. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

**1.09 QUALITY ASSURANCE**

- A. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.
- B. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.



### 1.10 PROJECT CONDITIONS

- A. Perform a full test of the existing system prior to starting work. Document any equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by University or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:
  - 1. Notify University no fewer than 20 working days in advance of proposed interruption of fire-alarm service.
  - 2. Do not proceed with interruption of fire-alarm service without University's written permission.
- C. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

### 1.11 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

### 1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
  - 2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.01 SYSTEM DESCRIPTION

- A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.
- B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and voice/strobe evacuation.
- C. Automatic sensitivity control of certain smoke detectors.
- D. All components provided shall be listed for use with the selected system.
- E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

## 2.02 SYSTEMS OPERATIONAL DESCRIPTION

- A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:
1. Manual stations.
  2. Heat detectors.
  3. Smoke detectors.
  4. Duct smoke detectors.
  5. Carbon monoxide detectors.
  6. Combustible gas detectors.
  7. Automatic sprinkler system water flow.
  8. Fire standpipe system.
  9. Dry system pressure flow switch.
  10. Fire pump running.
- B. Fire-alarm signal shall initiate the following actions:
1. Continuously operate alarm notification appliances, including voice evacuation notices.
  2. Identify alarm and specific initiating device at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Transmit an alarm signal to the remote alarm receiving station.
  4. Unlock electric door locks in designated egress paths.
  5. Release fire and smoke doors held open by magnetic door holders.
  6. Activate voice/alarm communication system.
  7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
  8. Activate stairwell and elevator-shaft pressurization systems, if existing.
  9. Close smoke dampers in air ducts of designated air-conditioning duct systems.
  10. Coordinate first subparagraph below with "Elevator Recall" Paragraph in "Fire-Alarm Control Unit" Article.
  11. Recall elevators to primary or alternate recall floors.
  12. Activate elevator power shunt trip.
  13. If supplies are not essential to life safety, retain first subparagraph below for shutoffs installed in supplies that may be hazardous.
  14. Activate emergency shutoffs for gas and fuel supplies. EXCEPTION: Gas shutoff to natural gas emergency standby generator.
  15. Record events in the system memory.
  16. Record events by the existing system printer.
  17. Indicate device in alarm on the graphic annunciator.
- C. Supervisory signal initiation shall be by one or more of the following devices and actions:
1. Valve supervisory switch.
  2. Elevator shunt-trip supervision.
  3. Fire pump running.
  4. Fire-pump loss of power.
  5. Fire-pump power phase reversal.
  6. Independent fire-detection and -suppression systems.
  7. User disabling of zones or individual devices.
  8. Loss of communication with any panel on the network.
  9. Carbon monoxide detection in generator room, transformer room, or boiler room..

- D. System trouble signal initiation shall be by one or more of the following devices and actions:
1. Open circuits, shorts, and grounds in designated circuits.
  2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
  3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
  4. Loss of primary power at fire-alarm control unit.
  5. Ground or a single break in internal circuits of fire-alarm control unit.
  6. Abnormal ac voltage at fire-alarm control unit.
  7. Break in standby battery circuitry.
  8. Failure of battery charging.
  9. Abnormal position of any switch at fire-alarm control unit or annunciator.
  10. Voice signal amplifier failure.
- E. System Supervisory Signal Actions:
1. Initiate notification appliances.
  2. Identify specific device initiating the event at fire-alarm control unit, connected network control panels, off-premises network control panels, and remote annunciators.
  3. Record the event on existing system printer.
  4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
  5. Transmit system status to building management system.
  6. Display system status on graphic annunciator.

### **2.03 FIRE-ALARM CONTROL UNIT (Existing)**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. SimplexGrinnell.
- B. General Requirements for Fire-Alarm Control Unit:
1. Fire alarm control unit, Simplex 4100ES is existing to remain. Existing programming shall remain as is unless new devices are required to be added to existing network. Existing panel is field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
    - a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    - b. Include a real-time clock for time annotation of events on the event recorder and printer.
    - c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    - d. The FACP shall be listed for connection to a central-station signaling system service.
    - e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.
  2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
  3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.
- C.

H. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 1.
3. Install no more than 50 addressable devices on each signaling-line circuit, unless existing system allows more than indicated.
4. Serial Interfaces:
  - a. One dedicated RS 485 port for remote station operation using point ID DACT.
  - b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
  - c. One USB port for PC configuration.
  - d. One RS 232 port for VESDA HLI connection.
  - e. One RS 232 port for voice evacuation interface.

D Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Elevator Recall:

1. Elevator recall shall be initiated only by one of the following alarm-initiating devices:
  - a. Elevator lobby detectors except the lobby detector on the designated floor.
  - b. Smoke detector in elevator machine room.
  - c. Smoke detectors in elevator hoistway.
2. Elevator controller shall be programmed to move the cars to the alternate recall floor if lobby detectors located on the designated recall floors are activated.
3. Water-flow alarm connected to sprinkler in an elevator shaft and elevator machine room shall shut down elevators associated with the location without time delay.
  - a. Water-flow switch associated with the sprinkler in the elevator pit may have a delay to allow elevators to move to the designated floor.

G. Door Controls: Door hold-open devices that are controlled by smoke detectors at doors in smoke-barrier walls shall be connected to fire-alarm system.

H. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity

adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

- I. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.
- L. Voice/Alarm Signaling Service: Central emergency communication system with redundant microphones, preamplifiers, amplifiers, and tone generators provided as a special module that is part of fire-alarm control unit.
  - 1. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different zones or for manual transmission of announcements by use of the central-control microphone. Amplifiers shall comply with UL 1711.
    - a. Allow the application of, and evacuation signal to, indicated number of zones and, at the same time, allow voice paging to the other zones selectively or in any combination.
    - b. Programmable tone and message sequence selection.
    - c. Standard digitally recorded messages for "Evacuation" and "All Clear."
    - d. Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of fire-alarm control unit.
  - 2. Status Annunciator: Indicate the status of various voice/alarm speaker zones and the status of firefighters' two-way telephone communication zones.
  - 3. Preamplifiers, amplifiers, and tone generators shall automatically transfer to backup units, on primary equipment failure.
- M. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.
- N. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.
  - 1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.
- O. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.
  - 1. Batteries: Sealed lead calcium.
- P. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

#### **2.04 SYSTEM SMOKE DETECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. SimplexGrinnell.
- B. General Requirements for System Smoke Detectors:
1. Comply with UL 268; operating at 24-V dc, nominal.
  2. Detectors shall be four or two-wire type. Match existing.
  3. 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.
  4. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
  5. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
  6. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
    - a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    - b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
    - c. Multiple levels of detection sensitivity for each sensor.
    - d. Sensitivity levels based on time of day.
- C. 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.).
- D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
  2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
    - a. Primary status.
    - b. Device type.
    - c. Present average value.
    - d. Present sensitivity selected.
    - e. Sensor range (normal, dirty, etc.).
  3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
  4. Each sensor shall have multiple levels of detection sensitivity.

5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
6. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

## **2.05 ADDRESSABLE INTERFACE DEVICE**

- A. General:
  1. Include address-setting means on the module.
  2. Store an internal identifying code for control panel use to identify the module type.
  3. Listed for controlling HVAC fan motor controllers.
- B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.
- C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.
  1. Allow the control panel to switch the relay contacts on command.
  2. Have a minimum of two normally open and two normally closed contacts available for field wiring.
- D. Control Module:
  1. Operate notification devices.
  2. Operate solenoids for use in sprinkler service.
  3. Operate smoke dampers.

## **2.06 NETWORK COMMUNICATIONS**

- A. Provide network communications for fire-alarm system according to fire-alarm manufacturer's written requirements.
- B. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
- C. Provide integration gateway using BACnet for connection to building automation system.

## **PART 3 - EXECUTION**

### **3.01 EXAMINATION**

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
  1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
  - 1. Devices placed in service before all other trades have completed cleanup shall be replaced.
  - 2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
  - 1. Connect new equipment to existing control panel in existing part of the building.
  - 2. Connect new equipment to existing monitoring equipment at the supervising station.
  - 3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- C. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor.
- D. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- E. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends.
  - 1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- F. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.
- G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

### 3.03 PATHWAYS

- A. Pathways above recessed ceilings and in non-accessible locations may be routed exposed.
  - 1. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.
- B. Pathways shall be installed in EMT.
- C. Exposed EMT shall be painted red enamel.



### 3.04 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
  - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
  - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
  - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
  - 3. Smoke dampers in air ducts of designated HVAC duct systems.
  - 4. Magnetically held-open doors.
  - 5. Electronically locked doors and access gates.
  - 6. Alarm-initiating connection to elevator recall system and components.
  - 7. Alarm-initiating connection to activate emergency lighting control.
  - 8. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
  - 9. Supervisory connections at valve supervisory switches.
  - 10. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
  - 11. Supervisory connections at elevator shunt-trip breaker.
  - 12. Data communication circuits for connection to building management system.
  - 13. Data communication circuits for connection to mass notification system.

### 3.05 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Install framed instructions in a location visible from fire-alarm control unit.

### 3.06 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
- B. Ground shielded cables at the control panel location only. Insulate shield at device location.

### 3.07 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction and University's Representative.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.

D.

- M. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Visual Inspection: Conduct visual inspection prior to testing.
    - a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    - b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
  2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
  4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
  5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
  6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
- 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 Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

### **3.08 MAINTENANCE SERVICE**

- A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
  2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

**3.08 SOFTWARE SERVICE AGREEMENT**

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
  1. Upgrade Notice: At least 30 days to allow University to schedule access to system and to upgrade computer equipment if necessary.

**3.10 DEMONSTRATION**

- A. Engage a factory-authorized service representative to train University's maintenance personnel to adjust, operate, and maintain fire-alarm system.

**END OF SECTION**

# **DAVIS-BACON WAGE DETERMINATIONS**

"General Decision Number: OH20240033 09/06/2024

Superseded General Decision Number: OH20230033

State: Ohio

Construction Type: Building

County: Athens County in Ohio.

BUILDING CONSTRUCTION PROJECTS (does not include single family homes or apartments up to and including 4 stories).

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

<p>If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:</p>	<ul style="list-style-type: none"> <li>. Executive Order 14026 generally applies to the contract.</li> <li>. The contractor must pay all covered workers at least \$17.20 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2024.</li> </ul>
<p>If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:</p>	<ul style="list-style-type: none"> <li>. Executive Order 13658 generally applies to the contract.</li> <li>. The contractor must pay all covered workers at least \$12.90 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2024.</li> </ul>

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number	Publication Date
0	01/05/2024
1	01/19/2024

2	03/08/2024
3	04/05/2024
4	07/05/2024
5	08/23/2024
6	09/06/2024

ASBE0080-001 02/26/2024

	Rates	Fringes
ASBESTOS WORKER/HEAT & FROST INSULATOR.....	\$ 35.00	30.52

BROH0052-004 06/01/2023

	Rates	Fringes
BRICKLAYER.....	\$ 32.43	20.44

BROH0055-007 06/01/2023

	Rates	Fringes
TILE FINISHER.....	\$ 28.31	10.45
TILE SETTER.....	\$ 29.92	16.77

CARP0356-002 05/01/2024

	Rates	Fringes
CARPENTER.....	\$ 31.61	25.98

ELEC0972-007 06/01/2023

	Rates	Fringes
ELECTRICIAN (Includes Low Voltage Wiring and Alarm Installation).....	\$ 35.45	30.25

ELEV0011-002 01/01/2024

	Rates	Fringes
ELEVATOR MECHANIC.....	\$ 55.01	37.885+a+b

PAID HOLIDAYS:

a. New Year's Day, Memorial Day, Independence Day, Labor Day, Vetern's Day, Thanksgiving Day, the Friday after Thanksgiving, and Christmas Day.

b. Employer contributes 8% of regular hourly rate to vacation pay credit for employee who has worked in business more than 5 years; 6% for less than 5 years' service.

\* ENGI0018-022 05/01/2024

	Rates	Fringes
POWER EQUIPMENT OPERATOR Bobcat/Skid Steer/Skid Loader; Bulldozer.....	\$ 44.02	16.41
Crane.....	\$ 44.14	16.41

Forklift.....	\$ 42.98	16.41
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IRON0550-012 05/01/2024		
	Rates	Fringes
IRONWORKER, ORNAMENTAL.....	\$ 34.70	22.88
-----		
IRON0769-001 06/01/2024		
	Rates	Fringes
IRONWORKER, STRUCTURAL.....	\$ 37.66	29.24
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LABO0083-003 05/01/2021		
	Rates	Fringes
LABORER		
Common or General; Mason		
Tender - Brick &		
Cement/Concrete.....		
	\$ 37.52	11.80
-----		
PAIN0093-003 12/01/2023		
	Rates	Fringes
PAINTER (Brush and Roller).....	\$ 29.29	23.69
-----		
PAIN1195-001 12/01/2023		
	Rates	Fringes
GLAZIER.....	\$ 32.47	13.25
-----		
PLAS0132-011 06/01/2024		
	Rates	Fringes
CEMENT MASON/CONCRETE FINISHER...	\$ 33.27	16.10
-----		
PLUM0577-001 06/01/2024		
	Rates	Fringes
PIPEFITTER (Excludes HVAC		
Pipe Installation).....	\$ 37.89	27.48
-----		
PLUM0577-003 06/01/2024		
	Rates	Fringes
PLUMBER (Includes HVAC Pipe		
Installation).....	\$ 37.89	27.48
-----		
SFOH0669-009 01/01/2024		
	Rates	Fringes
SPRINKLER FITTER (Fire		
Sprinklers).....	\$ 43.08	27.49
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SHEE0024-010 06/01/2022		
	Rates	Fringes



SHEET METAL WORKER (HVAC Duct and Unit Installation Only).....	\$ 33.53	26.36
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SHEE0033-008 06/01/2022

Rates Fringes

SHEET METAL WORKER (Excludes HVAC Duct and Unit Installation).....	\$ 31.73	27.44
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\* UAVG-OH-0001 01/01/2019

Rates Fringes

IRONWORKER, REINFORCING.....	\$ 29.44	22.68
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\* UAVG-OH-0002 01/01/2019

Rates Fringes

ROOFER.....	\$ 30.19	15.73
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SUOH2012-035 08/29/2014

Rates Fringes

DRYWALL FINISHER/TAPER.....	\$ 20.66	4.91
DRYWALL HANGER AND METAL STUD INSTALLER.....	\$ 22.27	14.40
LABORER: Pipelayer.....	\$ 18.37	4.79
OPERATOR: Backhoe/Excavator/Trackhoe.....	\$ 29.18	10.69
OPERATOR: Loader.....	\$ 22.69	8.01
OPERATOR: Paver (Asphalt, Aggregate, and Concrete).....	\$ 23.91	10.42
TRUCK DRIVER: Dump (All Types)...	\$ 19.33	6.55

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WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

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Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic

violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

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The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of ""identifiers"" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

#### Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than ""SU"" or ""UAVG"" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

#### Survey Rate Identifiers

Classifications listed under the ""SU"" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

#### Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

#### State Adopted Rate Identifiers

Classifications listed under the ""SA"" identifier indicate that the prevailing wage rate set by a state (or local) government was adopted under 29 C.F.R. 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 01/03/2024 reflects the date on which the classifications and rates under the ?SA? identifier took effect under state law in the state from which the rates were adopted.

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#### WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

- \* an existing published wage determination
- \* a survey underlying a wage determination
- \* a Wage and Hour Division letter setting forth a position on a wage determination matter
- \* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour National Office because National Office has responsibility for the Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations  
Wage and Hour Division  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator

U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board  
U.S. Department of Labor  
200 Constitution Avenue, N.W.  
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

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END OF GENERAL DECISION"

# **BID FORMS**

**FORM OF BID GUARANTY AND CONTRACT BOND**  
**(As prescribed by Section 153.571, ORC)**

KNOW ALL PERSONS BY THESE PRESENTS, that we, the undersigned \_\_\_\_\_  
\_\_\_\_\_ as Principal, at (Address) \_\_\_\_\_  
\_\_\_\_\_ and \_\_\_\_\_  
\_\_\_\_\_ as Surety, are hereby held and firmly bound unto  
\_\_\_\_\_ as Oblige in the penal sum  
of the dollar amount of the bid submitted by the Principal to the Oblige on (date)  
\_\_\_\_\_ to undertake the Project known as:  
\_\_\_\_\_.

The penal sum, referred to herein, shall be the dollar amount of the Principal's bid to the Oblige, incorporating any additive or deductive alternate Bids made by the Principal on the date referred to above to the Oblige, which are accepted by the Oblige. In no case shall the penal sum exceed the amount of dollars (\$\_\_\_\_\_). *(If the above line is left blank, the penal sum will be the full amount of the Principal's bid, including alternates. Alternatively, if completed, the amount stated must not be less than the full amount of the bid, including alternates, in dollars and cents. A percentage is not acceptable.)* For the payment of the penal sum well and truly to be made, we hereby jointly and severally bind ourselves, our heirs, executors, administrators, successors and assigns.

THE CONDITION OF THE ABOVE OBLIGATION IS SUCH, that whereas the above-named Principal has submitted a bid on the above-referred to project;

NOW, THEREFORE, if the Oblige accepts the bid of the Principal, and the Principal fails to enter into a proper contract in accordance with the bid, plans, details, specifications and bills of material; and in the event the Principal pays to the Oblige the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid and such larger amount for which the Oblige may in good faith contract with the next lowest bidder to perform the work covered by the bid; or resubmits the project for bidding, the Principal will pay the Oblige the difference not to exceed ten percent of the penalty hereof between the amount specified in the bid, or the costs, in connection with the resubmission, of printing new contract documents, required advertising and printing and mailing notices to prospective bidders, whichever is less, then this obligation shall be null and void, otherwise to remain in full force and effect. If the Oblige accepts the bid of the Principal, and the Principal, within ten days after the awarding of the contract, enters into a proper contract in accordance with the bid, plans, details, specifications and bills of material, which said contract is made a part of this bond the same as though set forth herein; and

IF THE SAID Principal shall well and faithfully perform each and every condition of such contract; and indemnify the Oblige against all damage suffered by failure to perform such contract according to the provisions thereof and in accordance with the plans, details, specifications and bills of material therefore; and shall pay all lawful claims of subcontractors, material suppliers and laborers for labor performed and materials furnished in the carrying forward, performing or completing of said contract; we, agreeing and assenting to, at this undertaking shall be for the benefit of any material suppliers or laborer having a just claim, as well as for the Oblige herein; then this obligation shall be void;

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

THE SAID Surety hereby stipulates and agrees that no modifications, omissions or additions, in or to the terms of said contract or in or to the plans and specifications, therefore, shall in any wise affect the obligations of said Surety on its bond, and it does hereby waive notice of any such modifications, omissions or additions to the terms of the contract or to the work or to the specifications.

SIGNED AND SEALED this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

PRINCIPAL:

\_\_\_\_\_

By: \_\_\_\_\_

\_\_\_\_\_

Print Name and Title

SURETY: \_\_\_\_\_

\_\_\_\_\_

By: \_\_\_\_\_

Attorney-in-Fact

\_\_\_\_\_

Print Name

SURETY COMPANY ADDRESS:

\_\_\_\_\_

Street

\_\_\_\_\_

City

State

Zip

\_\_\_\_\_

Telephone

SURETY AGENT'S ADDRESS:

\_\_\_\_\_

Agency Name

\_\_\_\_\_

Street

\_\_\_\_\_

City

State

Zip

\_\_\_\_\_

Telephone

**Ohio Museum Complex HVAC Improvements  
Lin Hall, Ohio University  
Athens, Ohio 45701**

NOTE 1 The wording of this Proposal shall be retained throughout, without change, alterations or addition. Any change in the wording may cause the proposal to be rejected.

**FORM of PROPOSAL - REBID**

TO: **Athens County Commissioners  
15 South Court St.  
Athens, Ohio 45701**

SUBMITTED BY: \_\_\_\_\_  
(Name of Contracting Company submitting bid)

Having carefully read and examined the "Instructions to Bidders," "General Conditions," "Supplementary Conditions," "Specifications" dated Rebid 09/09/2024 and "Rebid Drawings" dated 09/09/2024 for the **Ohio Museum Complex HVAC Improvements** prepared by BDT Architects and Interior Designers, 26 East Park Drive, Suite 101, Athens, Ohio, and having also received, read, and taken into account original bid the following Addenda:

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

and likewise having inspected the site and all the conditions affecting and governing the construction of said project, the undersigned proposes to furnish all materials and perform all of the labor necessary for the performance and completion of such items as are enumerated below in full accordance with the documents named above.

**ITEM 1: GENERAL TRADES CONTRACT**, includes all work in drawings and specifications

TOTAL BID, ALL Labor and Materials, for the sum of \$ \_\_\_\_\_

Total Sum in words: \_\_\_\_\_

It is understood and agreed that all Work to be performed under the contract shall be completed within **300 calendar days**, with milestones as noted in instructions to bidders unless an extension of time is granted by the Owner in accordance with the Contract Documents.

**BIDDER'S CERTIFICATION**

The Bidder hereby acknowledges that the following representations in this bid are material and not mere recitals:

1. Bidder has read and understands the Contract Documents and agrees to comply with all requirements of the Contract Documents, regardless of whether the Bidder has actual knowledge of the requirements and regardless of any statement or omission made by the Bidder which might indicate a contrary intention.
2. The Bidder represents that the bid is based upon the Standards specified by the Contract Documents.
3. Bidder has visited the site, become familiar with local conditions and has correlated personal observations about the requirements of the Contract Documents. The Bidder has no outstanding questions regarding the interpretation of the Contract Documents.



4. The Bidder and each person signing on behalf of the Bidder certifies, and in the case of a joint or combined bid, each party thereto certifies as to such party's organization, under penalty of perjury, that to the best of the undersigned's knowledge and belief: (a) the base Bid have been arrived at independently without collusion, consultation, communication or agreement, for the purpose of restricting competition as to any matter relating to such Base Bid, Unit Prices or Alternate bid with any other Bidder; (b) unless otherwise required by law, the Base Bid, any Unit Prices and any Alternate bid in the bid have not been knowingly disclosed by the Bidder and will not knowingly be disclosed by the Bidder prior to the bid opening, directly or indirectly, to any other Bidder who would have any interest in the Base Bid, Unit Prices or Alternate bid; (c) no attempt has been made or will be made by the Bidder to induce any other individual, partnership or corporation to submit or not submit a bid for the purpose of restricting competition.
5. Bidder certifies that upon the award of the Contract, the Contractor will make a good faith effort to ensure that all of the Contractor's employees, while working on property, will not purchase, transfer, use or possess illegal drugs or alcohol or abuse prescription drugs in any way.
6. Bidder agrees to furnish any information requested by the Owner to evaluate the responsibility of the Bidder.
7. Bidder agrees to submit the following submittals, within seven (7) days of the date of the Notice of Award, for execution of the Agreement:
  - 7.1 Workers Compensation Certificate;
  - 7.2 Certificate of Insurance (ACORD form is acceptable) and copy of additional insured endorsement.

If the Bidder is a corporation, partnership or sole proprietorship, an officer, partner or principal of the Bidder, as applicable, shall print or type the legal name of the Bidder on the line provided and sign the Bid Form. If the Bidder is a joint venture, an officer, partner or principal, as applicable, of each member of the joint venture shall print or type the legal name of the applicable member on the line provided and sign the Bid Form.. All signatures must be original.

President or owners name: \_\_\_\_\_

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

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

Mailing Address: \_\_\_\_\_

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

Facsimile Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Where Incorporated: \_\_\_\_\_

Federal Identification Number: \_\_\_\_\_

Contact for Contract processing: \_\_\_\_\_

ADDITIONAL SIGNATURE FOR JOINT VENTURE

President or owners name: \_\_\_\_\_

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

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

Mailing Address: \_\_\_\_\_

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

Facsimile Number: \_\_\_\_\_

Email Address: \_\_\_\_\_

Where Incorporated: \_\_\_\_\_

Federal Identification Number: \_\_\_\_\_

Contact for Contract processing: \_\_\_\_\_

**AFFIDAVIT OF CONTRACTOR OR SUPPLIER OF NON-DELINQUENCY OF  
PERSONAL PROPERTY TAXES**

O.R.C. 5919.042

STATE OF OHIO:

SS:

TO: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

The undersigned, being first duly sworn, having been awarded a contract by you for \_\_\_\_\_ hereby states that we are not charged at the time the proposal was submitted with any delinquent personal property taxes on the general tax list of personal property of any county in which you as a taxing district have territory and that we were not charged with delinquent personal property taxes on any such tax list.

In consideration of the award of the above contract, the above statement is incorporated in said contract as a covenant of the undersigned.

\_\_\_\_\_

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

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

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

SEAL

**NON-COLLUSION AFFIDAVIT**

State of Ohio

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

BID Identification: \_\_\_\_\_

CONTRACTOR: \_\_\_\_\_

being duly sworn, deposed and says that he is \_\_\_\_\_ (Sole owner, a partner, president, secretary, etc.) of \_\_\_\_\_, the party making the foregoing BID; that such BID is not made in the interest of or on behalf of any undisclosed person, partnership, company, association, organization, or corporation; that such BID is genuine and not collusive or sham; that said BIDDER has not directly or indirectly induced or solicited any other BIDDER to put in a fake or sham BID and has not directly or indirectly colluded, conspired, connived, or agreed with any BIDDER or anyone else to put in a sham BID, or that any one shall refrain from bidding; that said BIDDER has not in any manner directly or indirectly, sought by agreement, communication or conference with anyone to fix the BID price of said BIDDER or of any other BIDDER, or to fix any overhead, profit, or cost element of such BID price, or of that of any other BIDDER, or to secure any advantage against the OWNER awarding the contract or anyone interested in the proposed contract; that all statements contained in such BID are true; and, further, that said BIDDER has not, directly or indirectly, submitted his BID price or any breakdown thereof, or the contents thereof, or divulged information or data relative thereto, or paid and will not pay any fee in connection therewith, to any corporation, partnership, company, association, organization, BID depository, or to any member or agent thereof, or to any other individual except to such person or persons as have a partnership or other financial interest with said BIDDER in his general business.

Signed:

\_\_\_\_\_

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

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

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

SEAL

**CERTIFICATION REGARDING  
DEBARMENT, SUSPENSION, AND OTHER RESPONSIBILITY MATTERS  
PRIMARY COVERED TRANSACTIONS**

This certification is required by the regulations implementing Executive Order 12549, Debarment and Suspension, 34 CFR Part 85, Section 85.510, Participant's responsibilities. The regulations were published as Part VII of the May 26, 1988 Federal Register (pages 19160 - 19211). Copies of the regulation may be obtained by contacting the U.S. Department of Education, Grants and Contracts Service, 400 Maryland Avenue, S.W. (Room 3633 GSA Regional Office Building No. 3), Washington, DC. 20202-4725, telephone (202) 732-2505.

- (1) The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:
- (a) Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;
  - (b) Have not within a three-year period preceding this proposal been convicted of or had a civil judgment rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State, or Local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;
  - (c) Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State, or Local) with commission of any of the offenses enumerated in paragraph (1)(b) of this certification; and
  - (d) Have not within a three-year period preceding this application/proposal had one or more public transactions (Federal, State, or Local) terminated for cause or default.
- (2) Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

\_\_\_\_\_  
Organization Name

\_\_\_\_\_  
PR/Award Number or Project Name

\_\_\_\_\_  
Name and Title of Authorized Representative

\_\_\_\_\_  
Signature  
ED Form GCS-008 (REV.12/88)

\_\_\_\_\_  
Date

**AFFIDAVIT IN COMPLIANCE WITH SECTION 3517.13  
OF THE OHIO REVISED CODE**

STATE OF OHIO

COUNTY OF \_\_\_\_\_, SS:

Personally appeared before me the undersigned, as an individual or as a representative of

\_\_\_\_\_ for a contract for \_\_\_\_\_  
(Name of Entity) (Type of Product or Service)

to be let by the County of \_\_\_\_\_, who, being duly cautioned and sworn, makes the following statement with respect to prohibited activities constituting a conflict of interest or other violations under Ohio Revised Code Section 3517.13, and further states that the undersigned has the authority to make the following representation on behalf of himself or of the business entity:

1. That none of the following has individually made within the two previous calendar years and that, if awarded a contract for the purchase of goods or services in excess of \$500.00, none of the following individually will make, beginning on the date the contract is awarded and extending until one year following the conclusion of the contract, as an individual, one or more campaign contributions totaling in excess of \$1,000.00, to any member of the \_\_\_\_\_ County Board of Commissioners or their individual campaign committees:
  - a. myself;
  - b. any partner or owner or shareholder of the partnership (if applicable);
  - c. any owner of more than 20% of the corporation or business trust (if applicable);
  - d. each spouse of any person identified in (a) through (c) of this section;
  - e. each child seven years of age to seventeen years of age of any person identified in divisions (a) through (c) of this section (only applicable to contributions made on or after January 1, 2007).
  
2. That none of the following have collectively made since January 1, 2007 and that, if awarded a contract for the purchase of goods or services in excess of \$500.00, none of the following collectively will make, beginning on the date the contract is awarded and extending until one year following the conclusion of the contract, one or more campaign contributions totaling in excess of \$2,000.00, to any member of the \_\_\_\_\_ County Board of Commissioners or their individual campaign committees:
  - a. myself;
  - b. nay partner or owner or shareholder of the partnership (if applicable);
  - c. any owner of more than 20% of the corporation or business trust (if applicable);
  - d. each spouse of any person identified in (a) through (c) of this section;
  - e. each child seven years of age to seventeen years of age of any person identified in divisions (a) through (c) of this section (only applicable to contributions made on or after January 1, 2007).

Signature \_\_\_\_\_

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

Sworn to before me and subscribed in my presence this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_\_.

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

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

SEAL

## ADDITIONAL CERTIFICATIONS

**Project Name:** \_\_\_\_\_

**Grant Number:** \_\_\_\_\_

I certify that my company has the *facilities* to complete this job.

I certify that my company has the *labor force* to complete this job.

I certify that my company has the *equipment* to complete this job.

I certify that my company has the *administrative capacity* to complete this job.

I certify that my company has the *knowledge* to complete this job.

I certify that my company maintains a *drug free workplace*.

\_\_\_\_\_  
Name and Title of Authorized Representative

\_\_\_\_\_  
Signature & Date

## **BONDING AND INSURANCE REQUIREMENTS**

A state or local unit of government receiving a grant from the Federal government which requires contracting for construction of facility improvement shall follow its own requirement relating to bid guarantees, performance bonds, and payment bonds, except for contracts or subcontracts exceeding \$100,000.00. For contracts or subcontracts exceeding \$100,000.00, the Federal agency may accept the bonding policy requirement of the grantee provided the Federal agency has made a determination that the Government's interest in adequately protected. If such a determination has not been made, the minimum requirements shall be as follows:

- A. A bid guarantee from each bidder equivalent to ten percent of the bid price. The "bid guarantee" shall consist of a firm commitment such as a bid bond, certified check, or other negotiable instrument accompanying a bid as assurance that the bidder will, upon acceptance of his/her bid, execute such contractual documents as may be required within the time specified.
  
- B. A performance bond on the part of the contractor for 100 percent of the contract price. A "performance bond" is one executed in connection with a contract to secure fulfillment of all the contractor's obligations under such contract.
  
- C. A payment bond on the part of the contractor for 100 percent of the contract price. A "payment bond" is one executed in connection with a contract to assure payment as required by law of all persons supplying labor and material in the execution of the work provided for in the contract.



## EXPERIENCE STATEMENT OF BIDDER

The BIDDER/CONTRACTOR is required to state in detail, in the space provided below, what work of character similar to that included in this proposed Contract Documents it has done, to give reference and such other detailed information as it will enable the OWNER to determine responsibility including experience, skill and financial standing.

PROJECT NAME: \_\_\_\_\_ CONTACT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
PHONE: \_\_\_\_\_ FAX: \_\_\_\_\_  
EMAIL: \_\_\_\_\_ DATE OF PROJECT: \_\_\_\_\_  
DESCRIPTION OF WORK: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROJECT NAME: \_\_\_\_\_ CONTACT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
PHONE: \_\_\_\_\_ FAX: \_\_\_\_\_  
EMAIL: \_\_\_\_\_ DATE OF PROJECT: \_\_\_\_\_  
DESCRIPTION OF WORK: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROJECT NAME: \_\_\_\_\_ CONTACT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
PHONE: \_\_\_\_\_ FAX: \_\_\_\_\_  
EMAIL: \_\_\_\_\_ DATE OF PROJECT: \_\_\_\_\_  
DESCRIPTION OF WORK: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

PROJECT NAME: \_\_\_\_\_ CONTACT: \_\_\_\_\_  
ADDRESS: \_\_\_\_\_  
PHONE: \_\_\_\_\_ FAX: \_\_\_\_\_  
EMAIL: \_\_\_\_\_ DATE OF PROJECT: \_\_\_\_\_  
DESCRIPTION OF WORK: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_